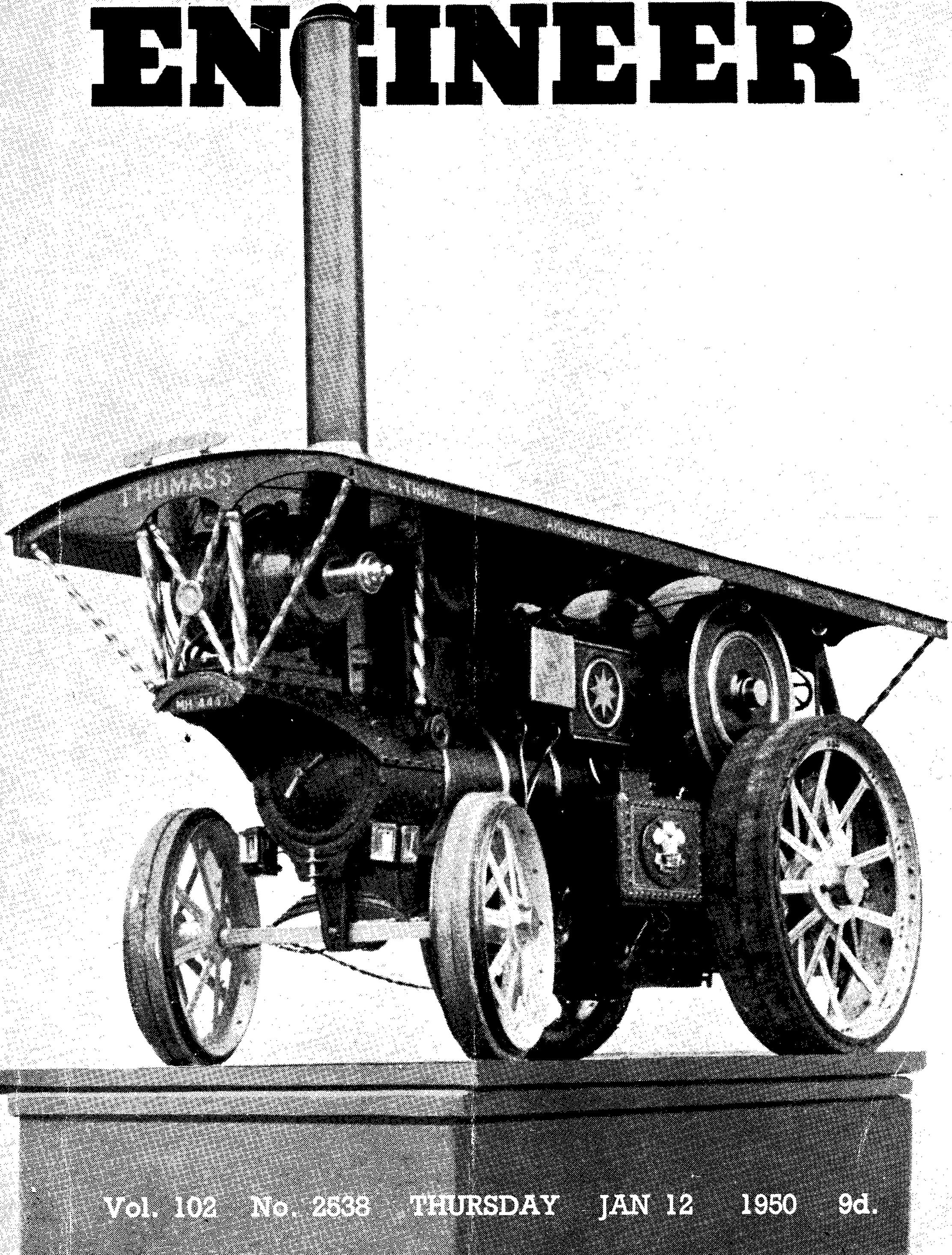
THE MODEL ENGINEER



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The MODEL ENGINEER

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SMOKE RINGS

A " Lone Hand " Story

● MANY OF our readers tell of us their early experiences in model engineering and all these stories are full of interest, particularly in respect of the difficulties which they have encountered in obtaining facilities and equipment for making models, and even more so in obtaining the necessary information. A letter recently received from Mr. H. Bristow, of Iver, Bucks, is fairly typical. He states that he learned his model engineering the hard way, and adds " I started at the age of fifteen by building a crude engine, and in the following ten years I had built, off my own bat, a piston- and poppet-valve engine, blowlamps of various types, and crude water- and oil-pumps. I kept very much to myself in those days, telling nobody what I did in my spare time, and, if the truth were known, feeling rather ashamed of myself for playing about with ' kids toys ' as a few people regarded them. We were bombed out in 1943, and I lost my workshop and all its equipment, including the results of my labours and spare cash for the previous ten years. It was a sad blow, and for a year or so, I did nothing in the model engineering line at all. Then one day I got into a train at Bristol to come to London, and an old gentleman sitting opposite was reading a queer-looking little publication called THE MODEL ENGINEER. I wondered, could it be that there were actually other people who were interested in the things I loved doing so much? I started to talk to him, and the two hours which it took the train to reach London never went faster. The result was that I invested some cash in copies of THE MODEL ENGINEER from 1937 to 1945-6, since when life has been really worth living. The only regret I have is that, had I known of the existence of THE MODEL ENGINEER ten years before, I would not have wasted so much time in getting nowhere. I had not even realised that such things as slide-valves existed. I have just finished building a lathe, and as soon as possible I hope to start model engineering afresh."

A Society for Totton

● WE NOW learn that, as a result of local discussions early in December last, the proposed Totton and New Forest Model and Experimental Engineering Society is formed and operating under elected executive officers and committee. The latter consists of six members, two each of which represent interests in locomotives, ships and general model engineering, respectively.

A temporary meeting room has been found at 106, Commercial Road, Totton, where monthly meetings are to be held.

The present members have under construction: three $\frac{3}{4}$-in. and four 1-in. scale locomotives, while one $\frac{1}{2}$-in. and one $\frac{3}{4}$-in. scale engines are completed; there are also some racing cars, ship models and other items to be seen. Mr. W. P. Pittman, " Sondrio," 20, Spicer's Hill, Totton, is hon. secretary.

Bennett College Jubilee

● ONE OF our oldest advertisers, The Bennett College, Sheffield, the famous study-at-home organisation which has helped thousands of men and women to reach highly-paid appointments in all fields of commerce, science and industry, is celebrating its 50th anniversary this year.

Since the college first opened in 1900 with a handful of students, it has grown year by year until today it is the leading postal tuition college in the world with a highly successful record in all fields of study. Bennett College-trained men are to be found holding important posts at home and abroad after studying under The Bennett College plan of personal tuition whereby the individual student receives training as thorough and as detailed as though the tutors were actually at his side.

With 50 years of successful experience of training by post behind it, and with an enthusiastic, expert staff ever ready to help the ambitious man to get to the top of whatever profession he has chosen, The Bennett College unlocks the door to prosperity and security by fitting him for the job, and with an exhaustive knowledge which will enable him to hold it.

Malden Society's New Secretary

● THE POST of hon. secretary of the Malden and District Society of Model Engineers is now held by Mr. George C. Smith, whose address is 101, Tudor Drive, Kingston-on-Thames. He has our best wishes for success in this important and exacting post. During 1949, the society carried through a heavy programme of events, and a glance at Mr. Smith's first News Sheet shows that the 1950 programme will be no less strenuous.

We are very glad to learn that the protracted negotiations for the lease of the piece of land at Thames Ditton have reached a satisfactory conclusion and that, as a consequence, the society can now look forward to removing the severe handicap of having no permanent headquarters. For a long time, plans for erecting suitable buildings and providing appropriate amenities on this land have been in existence ; now the realisation of these plans can be put in hand. We have no doubt that the work will be pushed forward with all possible speed.

Historic Locomotives

● AS A result of discussions between the Railway Executive and representatives of the principal societies interested in the preservation of historic locomotives, it has been agreed that, having regard to the difficulties of cost and maintenance which are involved in the preservation of actual locomotives in any numbers, examination should proceed of an alternative proposal for establishing a collection of models and/or drawings to portray the principal types which mark important stages in the development of the locomotive. With a view to developing this proposal, a small joint committee has been set up under the chairmanship of Mr. D. S. M. Barrie, the members being :—For the Railway Executive, Messrs. R. C. Bond and E. S. Cox ; for the societies, Messrs. A. Stowers and G. R. Grigs.

Among the questions which this committee has been examining, is the extent to which suitable models of historic locomotives are already available in reasonably accessible locations, and enquiries on these lines are being set on foot both by the Railway Executive and among the members of the various societies.

While this investigation into the possibility of a collection of historic models is proceeding, the Railway Executive are safeguarding from premature disposal any locomotive name-plates, etc., which may become surplus through the withdrawal of engines, and which may be considered as being of historic interest. As regards the future preservation of actual locomotives, the Railway Executive while emphasising the great problems of accommodation, maintenance, and expense, have not definitely precluded this possibility and have agreed that certain existing locomotive "last examples" which are of historic interest, shall not actually be scrapped on withdrawal from traffic, without the societies' representatives being consulted.

Another Old Ship Passes

● *Aquitania*, too well known to need further description, has run her last trip and is withdrawn from the cross-Atlantic traffic she has served so nobly for thirty-four years. At the moment of writing, her ultimate fate seems undecided ; there is, however, very little hope but that she will meet the same fate as that of her more celebrated sister, the old *Mauretania*, in a shipbreaker's yard.

The last sight we had of *Aquitania* was from the pier at Southsea, one early evening last August, when she sailed by majestically on an outward trip from Southampton to New York. Curiously enough, on this occasion, just as she was off Southsea pier, at a distance of about two miles, she sounded a long blast from her deep-voiced hooter, leaving us to guess the reason for this unusual salute.

Unlike *Mauretania*, *Aquitania* never entered the contests for the Blue Riband of the Atlantic ; therefore, her career has not attracted so much attention as her contemporary's. But there was a time when these two ships together, each in her own way, were the pride of the Atlantic. Maybe, in the not too distant future, we shall see other ships engaged in friendly rivalry for the coveted Blue Riband. Or does that kind of thing belong only to the past, when travel really was travel, and speed was not merely a means to an end ?

However that may be, there will be other ships which, like *Aquitania*, will content themselves with serving the needs of Atlantic passengers faithfully and efficiently, year after year, in fair weather or foul, without desire to take part in speed contests.

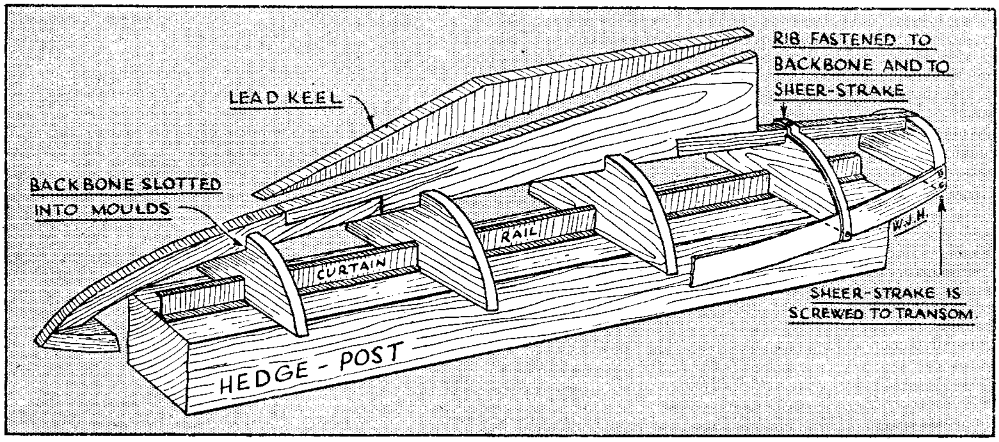
In bidding a last farewell to *Aquitania*, we are proud to recall that we knew her and her more sprightly companion when both were in their prime, symbols of more spacious and less austere days ; the recollection, we feel, will never be eradicated.

A Triumph Over Adversity

Building Models in Hospital

by W. J. Hughes

IT was recently my privilege to talk to a young man whose model-making is so endowed with grit, ingenuity, and determination that the result might well be considered a higher achievement than the winning of a high award at THE MODEL ENGINEER Exhibition. This is a strong statement to make, and I am sure that the young man and withal is a patience and a philosphical outlook on life which in part must be innate but may have been engendered partly by incapacitation. Add to this a cheery determination to achieve results, and you will have something of the qualities possessed by this modest and unassuming young man. (The personal facts



Diagrammatic sketch of Mr. Thackray's method of building his hull-frame. In actual practice there were twelve moulds, and the ribs were let in to the backbone

himself, Mr. Kenneth Thackray, of Wakefield, would be the first to deprecate it; but if the reader will imagine himself in the same position, I think he will agree with me.

The position is this: You have been in hospital for more than two years; in fact, of the past eight years you have spent more than four in hospital. Your time must be spent mostly in bed or otherwise resting, with little time on your feet. Sawing, planing, and similar actions are too strenuous for you, and might bring on a relapse. You have no bench or vice available, and work must be held in the hands, or between your feet, or in any other way that your ingenuity can devise. All work, tools, materials and reference books must be stored neatly when not in use, in the corner of a sitting-room attached to the hospital ward, and must not take up too much room. Financial resources are limited, and materials must be largely what you can "scrounge." There *are* other difficulties, but perhaps that will do to be going on with.

Against all this, however, you have had a deep love of ships ever since being a boy, which has been fostered by reading as much as possible about them ever since. Coupled with this is a desire to create, to build something worth-while, in this story had to be more-or-less dragged out of him, I mav say.)

Mr. Thackray's interest in ships started when he was a boy, and he used to spend many hours by the canal, expecially during the summer holidays. Friendly bargemen would allow him to steer single barges down from the colliery to the river, and would give him advice and assistance in carving model barges and other vessels from odd pieces of flotsam. On leaving school, came a short spell of office-life, but at the age of 18 there was a breakdown in health, and he had to enter hospital for a long period.

Between then and now there have been brief glimpses of the outside world, but more time has been spent in hospital than out of it.

A Workshop of His Own

During one of these intervals of outside life, Mr. Thackray achieved a long-felt ambition in acquiring a workshop of his own. There was no room at home, but he rented a small shop, installed a bench and vice, and began that accumulation of tools, one or two at a time, which is the way by which nearly all our workshops grow.

And then, just as he was getting nicely fixed

up, there came a relapse, and back into the hospital he went for another long spell. As a result, the workshop had to be given up, and the tools disposed of.

This is only one of the disappointments which would have disheartened many a lesser man, but Mr. Thackray could tell me about it without rancour, and with a mention of the fact that when he is again recovered he intends that his next workshop will contain a small lathe which will be useful in making the miniature fittings which his ship-modelling requires.

Some of the Models

The first model attempted in hospital by Mr. Thackray was of the *Cutty Sark*. This was made for another patient, who purchased a commercial kit, in which the hull was partly shaped from balsa. The model was successfully completed, having been constructed mostly in bed; though, like all good model engineers, the builder says he was not entirely satisfied with it. But then who is completely satisfied with his own work? There are always points that we know are not *quite* all they should be. In any case, the recipient of the *Cutty Sark* model was very pleased with it, but the builder says that he doesn't like working from kits and will not do so again if he can help it.

The next model was of a two-masted topsail schooner, built from a drawing by Underhill. It was scaled down to $\frac{1}{8}$ in. to 1 ft., resulting in a hull about 9 in. or 10 in. long. The reason for this scale was that the hull had to come out of an oak hedge-stake which had been found in the hospital grounds, and this limited the beam of the model.

When this model was being built, Mr. Thackray had the use of a bench and vice in the cellar under the hospital block, though the heat from the boilers was intense and it was not possible to work for more than ten minutes or so before seeking fresh air. Now, however, the bench has gone, and the vice with it.

A Museum Model

Next came the interlude of "outside" life, when Mr. Thackray was discharged from hospital and acquired his own workshop. During this period he built a small solid model of an M.T.B., and a waterline model of the *Golden Hind*. The latter was to $\frac{1}{16}$ in. scale, and was built of cardboard and paper, with a sea modelled from Pyruma cement.

But the job which I think Mr. Thackray enjoyed as much as any was the reconditioning of a model ship for the Wakefield Museum. This was of the *Star of Bethlehem*, a three-masted ship presumably of the early nineteenth century, since she had an almost clipper-like bow combined with a square stern containing windows, somewhat similar to the Blackwall frigates of that era. Perhaps some readers may have detailed knowledge of this vessel, and if so we should be glad to hear from them. I cannot trace the name in my own records, though it seems familiar.

The model, about 4 ft. 6 in. long, had been in store for a number of years, and had suffered badly in the rigging. The bowsprit was broken and the spanker boom and gaff were missing, as were sundry other fittings. Most of the blocks were of boxwood, but a few were of lead, and these had crystallised, as so often happens to lead with the passage of time.

Mr. Thackray was given to understand that the model was originally built by the captain of the ship, who left it to the museum in his will. There were no drawings available, of course, and so in reconditioning the model Mr. Thackray had to use the knowledge gained in his years of reading about ships. (In passing, I may note that his knowledge of rigging, especially, appears extensive.) The first thing to be done was to remove quite a number of lead sailors, grossly overscale, which had been glued to the decks indiscriminately! A general clean-up followed, and new spars were shaped and other fittings made. Then came rigging repairs, with much reference to Underhill's book on rigging, and the vessel was ship-shape once more. One point I should have mentioned before, by the way, is that the sails are modelled as furled, and are carved in one with the yards, from the solid.

A Working Model Sloop

Back in hospital again, Mr. Thackray is working at present on a model sloop about 25 in. long. As with his other hospital work, much ingenuity has been expended in "making do" with materials that are at hand, and the hull is almost complete, ready for fitting the deck.

It was built on the mould and rib principle, which is explained by my rough sketch and as follows: The moulds are cut to the shapes of the cross-sections of the hull at regular intervals, and are mounted upside down on a building board at the correct spacing. The keel or backbone is slotted into the moulds, and sheer strakes are fitted at the gunwales. Ribs are then fastened to the keel and to the sheerstrakes, and the planks, or other covering, are laid over the ribs. The hull is now lifted clear of the moulds, which of course play no part in the final structure of the boat.

In this case the moulds were cut from the sides of a wooden box, and the "building-board" was a 3-in. × 3-in. oak hedge-stake found in the hospital grounds. To this was fastened, on edge, a length of brass curtain-rail, and each mould was notched centrally on the deck-line to fit tightly over it, in order to hold the moulds upright and in line. A built-up backbone had been made of five pieces of deal, bolted together with 6-B.A. brass studding, and this was fitted into the slots cut in the moulds.

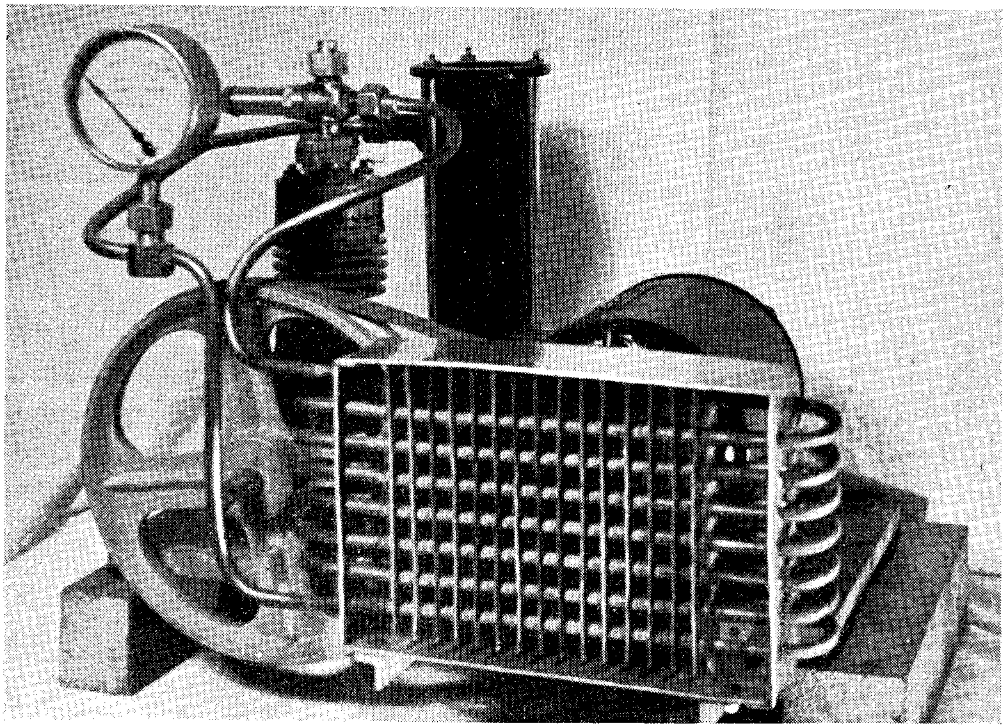
The ribs were made from strips cut $\frac{1}{4}$ in. wide from scrap aluminium sheet given by a coachbuilder friend, bent to shape, fitted to the moulds, and secured to the backbone and to the inner sheer strakes, which had been cut about $\frac{3}{4}$ in. wide from a scrapped copper gas-boiler.

Planking was out of the question—the material was not available, and in any case accurate fitting would have been almost impossible in the circumstances. The covering was therefore commenced with paper, which Mr. Thackray had seen mentioned in THE MODEL ENGINEER. Each layer was glued on and allowed to harden

(*Continued on page* 39)

*A Domestic Refrigerator

by L. C. Sherrell



Showing a suitable position for the pressure gauge

THE lock and catch, Fig. 17, can be fabricated in brass, or will someone cast a few sets in gunmetal? They are, of course, chromium-plated when finished.

I've left the dryer, Fig. 18, until last, because if the baking business has been carried out properly it won't be required. We shan't know for certain until the unit is charged, but here it is:—

Simply a small container packed with calcium chloride, or silica gel, between two wads of cotton wool with a fine brass gauze strainer at each end. The end caps are screwed on to the tube and finally sweated round to prevent leakage.

This assembly is fitted into the liquid line close to the liquid receiver. As the offending moisture comes along, it is absorbed by either one of these drying agents, thus preventing icing up and choking the expansion-valve.

Room Temperature	Pressure High Side	Pressure Low Side	On Period	Off Period
60 deg. F.	75-80 lb.	8 lb.	4 min.	30 min.
65 deg. F.	80-85 lb.	8 lb.	4 min.	25 min.
70 deg. F.	85-90 lb.	8 lb.	4 min.	18-20 min.

Charging the Unit

A pressure gauge registering not less than 150 lb. per sq. in. will be required and I suggest it be inserted permanently in the system where it can be seen in the photograph, and also on the actual job when the flap is opened; the reason being that the pressures I shall give are for *this*

*Continued from page 5, " M.E.," January 5, 1950.

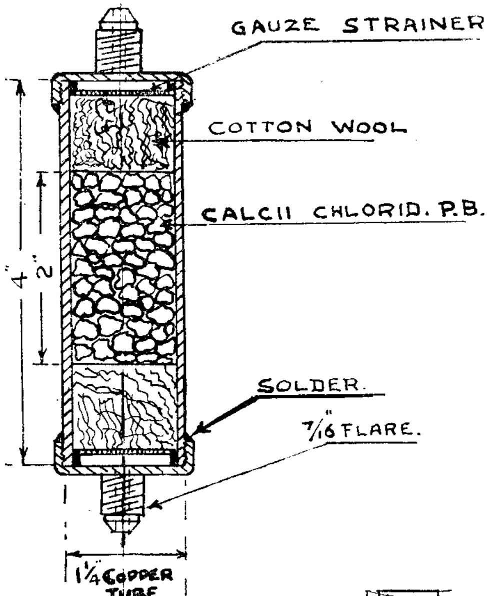


Fig. 18. *The dryer*

particular refrigerator and have been proved over a number of months to be the most satisfactory working pressures, taken with the gauge in this position. No doubt these pressures would be slightly higher if it were fitted to the proper service flare provided on the discharge shut-off valve, as here the gas has as yet to be cooled and liquefied.

Also required is a compound gauge fitted in a tee-piece to about 2 ft. of $\frac{1}{4}$-in. copper pipe with $\frac{7}{16}$-in. flare-nut at each end to connect to suction shut-off valve and methyl chloride cylinder. The compound gauge should read 30 in. mercury to 150 lb. pressure; normally, of course, the pressure will never exceed 20 lb., but should the discharge or expansion-valves leak, the total pressure is thrown upon this gauge.

In the table on the previous page are the pressures and results, etc., that can be expected.

It will be found that when the unit stops running and slowly cools down, these pressures will also come down to approximately room temperature, while the low side will very slowly rise to 20 lb., indicating that the temperature within the coil has also risen to approx. 25 deg. F., at which the cold control switch will cut in if set at normal running.

The photograph showing the evaporator has just a week's frost on it; if the defrosting periods are extended beyond this time, the running periods will gradually increase.

As near as I could weigh the methyl chloride on the household scales, 1 lb. will be sufficient. It is obtainable in cylinders containing 5 lb. If this is the first attempt at charging a "fridge," it may help to have these notes handy.

Connect the suction line $\frac{7}{16}$ in. flare and gas cylinder together with the $\frac{1}{4}$-in. charging pipe complete with compound gauge. Purge air out of charging pipe by turning on gas and slacking flare-nut on shut-off valve; tighten immediately line has been purged. Close suction-valve to return port, i.e. turn all the way to the right. Open both discharge and receiver-valves. Slack off $\frac{5}{8}$-in. flare-nut on $\frac{3}{8}$ in. return pipe to suction shut-off valve, and open gas cylinder until the gas can be heard escaping. This will purge any air out of the system. Tighten up flare-nut, and open suction-

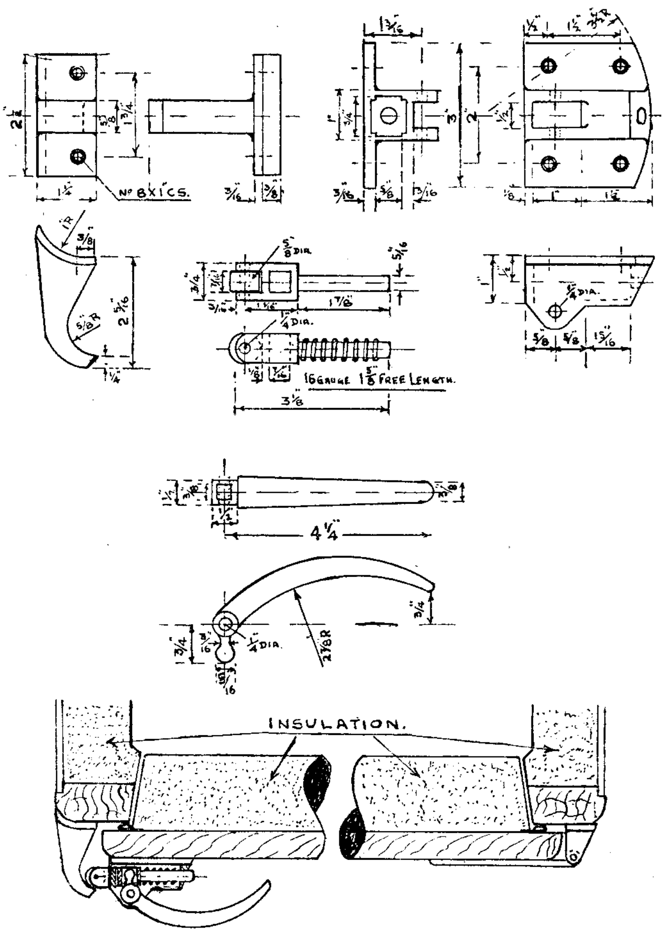


Fig. 17. *Details of the lock and catch*

valve to both ports. The pressure (high side) will now read approx. 50 lb.

The unit can now be switched on and the expansion-valve set to give a reading of 8 lb. pressure (low side). When the pressure reaches the amount as given, shut down the cylinder, and after running for 15 min., the evaporator coil should be coated with frost. Set the cold control-switch to normal and let it cut in and out about three times just to make sure everything is O.K.

To dismantle charging line, close suction-valve (all the way to left) and replace sealing caps. For the tyro's benefit, if favourable results cannot be obtained everything can easily be checked and rectified.

The most likely snag will be leaks, and these are usually detected by using a lamp that will pick up any escape of gas, which causes the flame to turn green. This method is not available to amateurs, but soapy water worked up to a good lather will track down most leaks. It is the very slight ones that are difficult, and it will generally be found that wherever there is a leak, oil will be present, so a good tip is to keep all joints perfectly clean. If the compound gauge drops to zero after running for a few minutes, it is reasonable to assume that moisture is present in the system, so the dryer will have to be inserted as described. By so doing, the area will be increased and possibly a little more gas needed.

If, when stationary, the compound gauge reads the same as the pressure side, the discharge-valve is leaking. To be sure of this, shut the suction shut-off valve and run the compressor until a 20-in. vacuum has been reached. If it is holding properly, the reading will not alter much in a 10-min. period; if it moves quickly to zero, the valve is in need of attention.

Should the expansion-valve leak, the low pressure side will greatly exceed the 8 lb., causing the compressor to become noisy as it tries to compress liquid; also, the suction pipe will frost up right down to the crankcase. This trouble can be caused by the needle-valve within the expansion-valve wearing and not making a good seat; a new one can be made of silver-steel and tempered. Before making any of these adjustments be sure to close the receiver shut-off valve and run the compressor until a 20-in. vacuum is reached, and then close suction shut-off valve. This will prevent losing any gas.

I think that just about completes it, and I take this opportunity of thanking Mr. T. H. Hewitt who has assisted me greatly with the drawings, and Mr. H. Hibben for the photographs.

A Triumph over Adversity

(*Continued from page* 36)

before the next layer was fitted, until a thickness of about $\frac{1}{8}$ in. was achieved. Then came two layers of cloth, applied in strips torn about $\frac{3}{4}$ in. wide from some old pyjamas.

The hull having been removed from the moulds, deck-beams were fitted. They are cut from $\frac{1}{4}$-in. oak (the coach-builder friend again!) and fastened to the hull by means of angle-brackets cut from the copper boiler, held by 6-B.A. screws and nuts.

A pattern was made in deal for the keel-weight, and was moulded in building-sand. Scrap lead, melted in a tin on the ward sitting-room fire, was used for the casting, but three attempts were necessary before Mr. Thackray was satisfied. The weight was drilled, and secured to the backbone by 6-B.A. studding. Those who have drilled any thickness of lead by hand will appreciate the perseverance necessary, when no vice was available!

A rudder-tube is fitted, made from $\frac{1}{4}$ in. copper pipe, passing through a hole bored in the backbone and clipped at its upper end to a deck-beam. After painting the hull, outer sheer-strakes of plywood were fitted—this was the only available material flexible enough. The builder hopes to fix up a steaming apparatus for bending stringers before long, however—there seems no limit to his ingenuity.

As I mentioned, the hull is now almost complete. It has had three coats of paint, and is amazingly strong. Flotation tests have been carried out in the gardener's water-tank, and the hull floats to its correct water line and is leak-proof. The general lines are sweet and good, with a nicely curved sheer, but there are slight evidences of "sagging" of the covering in between the ribs, as one might expect. However, it will not be difficult to fill these before the final coats of paint are put on. The deck will be of plywood, and the mast and spars tapered from dowelling. Mr. Thackray has already purchased a piece of "surplus" nylon from which the sails will be made.

Other Hospital Activities

In addition to his model-making carried out under such grave handicaps, this young man manages to carry out other activities—for example, he had just repaired a violin for a fellow patient, including reducing the bridge and making a new peg. He also grows his own tobacco in the hospital garden, cures it himself, and presses it in a "home-made" press. When complete rest is the order of the day, he likes to read, or to listen to classical music on the radio, or to practise drawing and painting—he is taking a course in Commercial Art in preparation for the future.

* * *

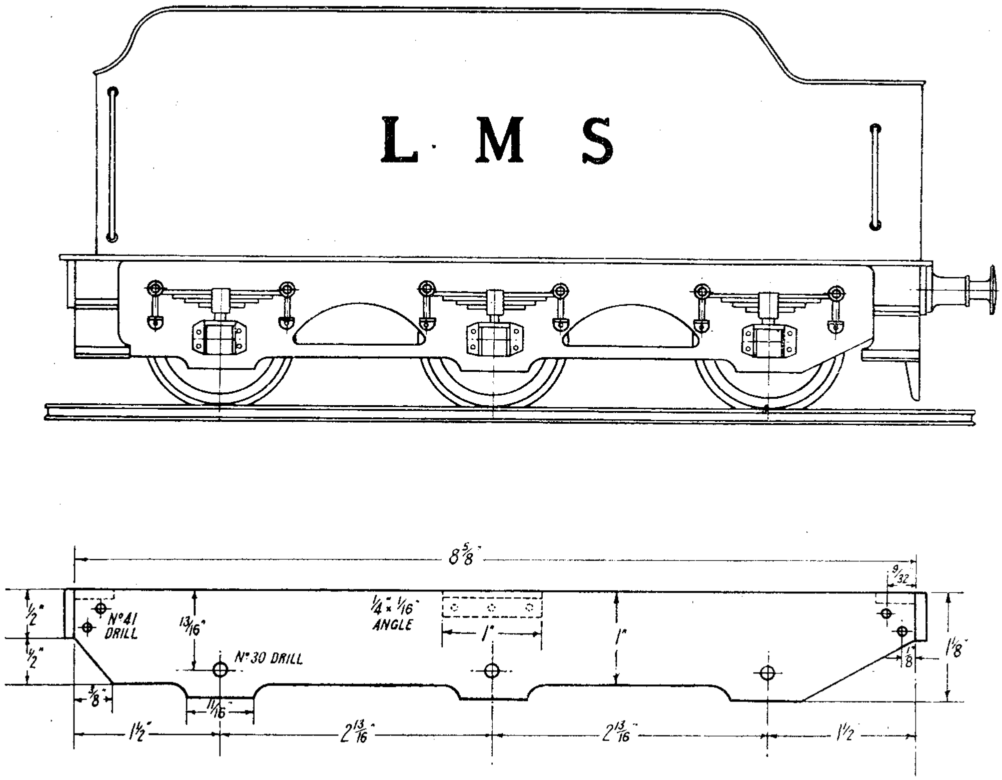
And so, gentle reader, when next anything goes wrong in your own workshop, however meagrely (or luxuriously) equipped, just give a thought to the conditions under which Mr. Thackray works, and I feel sure that your own difficulties will be greatly minimised. His courage, cheer, and determination have certainly had the effect of making me realise how fortunate are we who not only enjoy good health, but also reasonably good workshop conditions. I am sure, too, that all readers will join in wishing Mr. Thackray well, with a good recovery in health and all success in the future.

Tender for the Wee "Dot" like "Doris"

by "L.B.S.C."

As full instructions were given for building the tender for the $3\frac{1}{2}$-in. gauge engine, there isn't much to say about the tender for the little one; but the latter differs a little, inasmuch as there is no coal space, and an extra tank is carried for methylated spirit. If anybody prefers to fit an oil-burner, leave out this tank; and, all being well, I will give the drawings and a few notes for a suitable oil-burner of the "axle-dodger" type. The tank for this will be circular, and will fit in the space allotted to the "poison-gas" container.

As will be seen from the accompanying outline drawing, the tender differs little in personal appearance from "Doris's" tender, but it is much simpler to build up. The frames can be made from any bits of 16-gauge metal you have handy; brass, steel, or galvanised iron, will do equally well. No horn slots are needed, the axles running through plain drilled holes in the frame, into blind holes drilled in the axleboxes. There is no need to spring this little tender when the engine is used on an indoor "scenic" railway. Our "approved" advertisers can supply little castings comprising axlebox, hornchceks, spring and hangers all cast as a single unit; and all they need is a clean-up with a file (a couple of samples received, don't even need that much, being very clean) and the hole drilled for the axle. The easiest way for beginners to do this, is to rivet the casting to the frame, by two $\frac{1}{16}$-in. rivets through the ends of the dummy spring, taking care to locate the axlebox centrally over the hole in frame; then poke the No. 30 drill through the hole in the frame, and carry on nearly, but not quite, through the axlebox. An inch of $\frac{1}{16}$-in. by $\frac{1}{4}$-in. brass angle is riveted to each side, as extra support for the soleplate, which is screwed down to it.

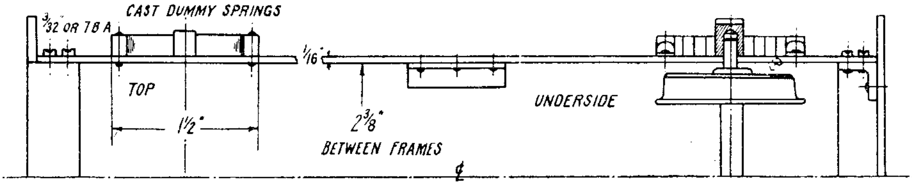


General arrangement. and frame of tender

The drag-beam and buffer-beam are made from $\frac{1}{2}$-in. by 3/32-in. angle, brass or steel. They are drilled and slotted on the vertical faces, same as the engine, but the tops are not slotted, merely cut the corners away as shown, and rivet pieces of angle flush with the edges of the cut-away part. You can't very well braze up this frame assembly,

otherwise you won't be able to get the wheels and axles in; one side of the frame has to be detachable for this purpose. The frames are screwed to the bits of angle as shown in the illustration. Maybe our advertisers would supply cast beams with lugs instead of angles, to which the frames could be screwed.

The wheels and axles are turned, as described for the bigger engine (beginners can follow the machining instructions given for "Tich") and, as mentioned above, are put in place when the frames are screwed to the beams. The little chassis thus far constituted, shouldn't rock when placed on the lathe bed or something equally flat and level; and—hold your breath—it won't collapse if you stand on it! The true test for a locomotive frame is not to stand on it, but bash it cornerwise against a concrete post or something equally solid. This test won't hurt a frame with angle buffer beams, but it will probably make a lovely rhomboid of one with plate beams and thin staying. I've seen 'em! If the end wheels touch the flat surface, and the middle ones don't, put a drill a shade larger in the middle bearing holes. This may upset Inspector Meticulous, but it won't affect the running of the tender one iota, and that is all that matters.

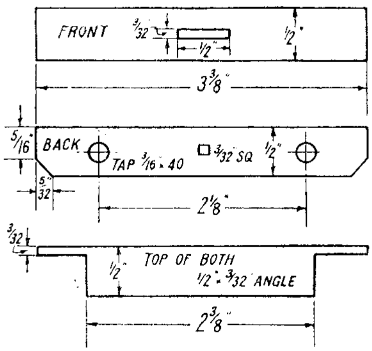


Part plan of frames erected

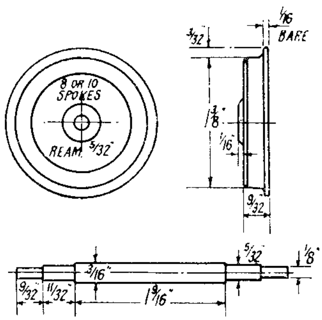
Tender Body

The soleplate is made from 18-gauge brass or copper, and is $8\frac{15}{16}$ in. long by $3\frac{1}{2}$ in. wide. It is attached to the chassis by 3/32-in. or 7-B.A. brass screws through the tops of beams, and side angles, the screws being nutted underneath, as usual. There is no valance on the L.M.S. tenders of this type. The sides and back of the body can be made from a single strip of 20- or 22-gauge brass or copper—hard-rolled brass is the stuff I use—and it may be soldered direct to the soleplate, merely putting a little bit of angle near each front end, and another little bit at the back. No need to rivet or screw them; just drop in place, solder over the lot, and don't forget to cover the screw-heads. Cut a division plate from the same material as the body, and solder it across the body at $5\frac{1}{2}$ in. from the back end; this should be $1\frac{3}{4}$ in. high, and a nice fit between the two sides. The space between this plate and the back of the body, forms the water-tank. Rivet a piece of $\frac{1}{4}$-in. by $\frac{1}{16}$-in. angle-brass along the top, and along each side and back, as shown in the section, for attaching the removable cover-plate. This is made and fitted as described for the $3\frac{1}{2}$-in. engine, and has a filler hole with hinged lid as shown.

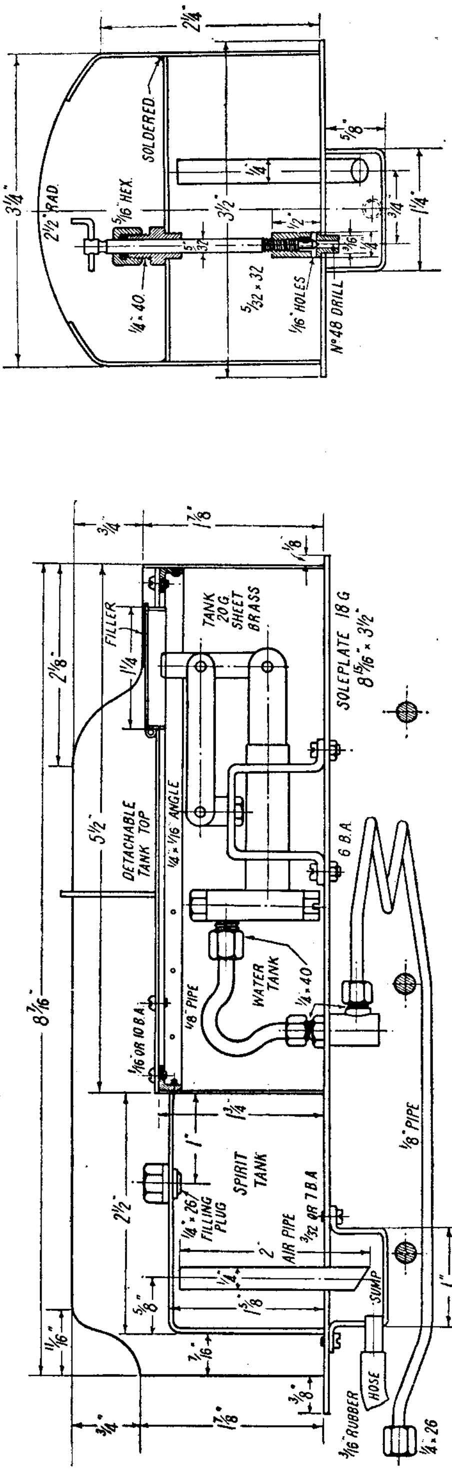
The spirit tank is made from a piece of sheet metal, same kind as tender body, $4\frac{1}{8}$ in. long, and just wide enough to fit between the sides. Bend it at right-angles, at $2\frac{1}{2}$ in. from one end; drill the hole for the filler-plug bush before soldering it in place, then fit the bush and solder that in too. A 2-in. length of $\frac{1}{4}$-in. thin brass or copper tube, is soldered into a hole drilled in the soleplate, $\frac{3}{8}$ in. off centre line, and $1\frac{3}{8}$ in. from front edge of soleplate; bevel off the bottom as shown. Level with this, and $\frac{3}{8}$ in. off the opposite side of centre line, fit the fuel valve shown in the cross-section of the tank. This is merely a long-stemmed edition of an ordinary screw-down valve, with a valve pin or spindle $2\frac{1}{2}$ in. long, made from rustless steel or bronze rod 5/32 in. diameter. The upper end passes through a gland, soldered into the top of the tank. If



Buffer and drag beams



Wheels and axles



Left—Longitudinal section of body   Right—Cross section through spirit tank

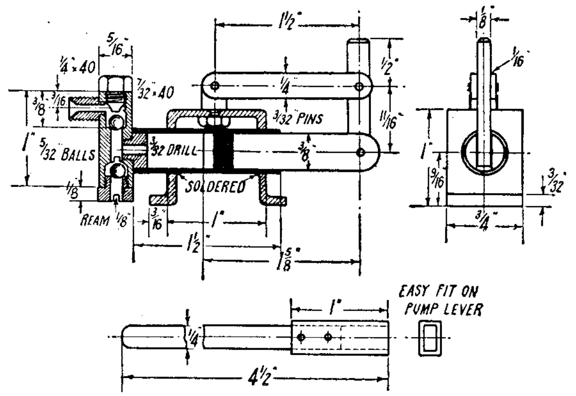
beginners drill the hole in the tank top first, with a $\frac{3}{16}$-in. drill, then carry on through the soleplate, using the hole in the top as guide, the holes will be in line. Open out the top hole to $\frac{1}{4}$ in. clearing size; 7 mm. or 17/64 in. will do, and turn the spigot on the under-side of the gland to suit. Assemble your valve, poke it through the hole in the top, wangle the $\frac{3}{16}$-in. spigot of the valve itself, through the hole in the soleplate, press the gland body down into the hole in the top, and solder around both. The sump is a little tank bent up from a piece of sheet brass $1\frac{1}{4}$ in. wide, leaving a lug or flange at each end for attachment to under-side of soleplate by two screws, as shown in the longitudinal section of the tender body. The sides are cut from the same kind of metal, and soldered in; a short bit of $\frac{3}{16}$-in. thin tube is soldered into the front, right at the bottom. When the engine is coupled to the tender, a piece of rubber tube is slipped over this, the other end being attached to the similar bit of pipe on the little cross-drum connecting the burner feed-pipes. Thus the spirit will stand at the same level in the burner tubes, as it does in the sump; and the little drum will ensure that none of the wicks are starved of fuel. In days gone by, when I had more energy, and could do a little to help friends out of trouble. I fitted several $2\frac{1}{2}$-in. gauge engines with this type of feed and burners. The original burners were made entirely of thick copper tube, with feed-tubes far too small; the consequence was, that when they got hot, the spirit boiled, vaporised, and blew the contents of the feed tubes either back into the tank, or out of the sump, if they had one. The flames then died down until the tubes cooled a little; then back came the spirit, up went the flames, the tubes heated up again, and the whole process was repeated I tried to explain the cause of the trouble, to the designer, in a friendly sort of way, but he would not take the slightest notice. Such is the way of the world!

Tender Hand-pump

The tender hand-pump is made as described for "Doris" and other engines in this series of notes, but is naturally smaller. There is, of course, no need to keep to the exact type shown; one of our advertisers, Messrs. A. J. Reeves & Co., supply little castings embodying the base, barrel, and anchor lug on top. All this casting needs, is drilling and reaming for the ram, and drilling for the holding-down screws and the anchor-link pin. A cast valve-box is also supplied, with a projection on the side for turning and pressing into the barrel. The valve-box itself is machined up exactly the same as one made from rod, and assembled exactly the same as one with a bent-up stand, and barrel made from tube.

If the built-up job is preferred, the whole bag of tricks is shown in the accompanying illustration. The stand is bent up from a piece of $\frac{3}{4}$-in. by 3/32-in. brass or copper, with a $\frac{7}{16}$-in. hole drilled through both sides at $\frac{9}{16}$ in. from the bottom. The barrel is a piece of $\frac{7}{16}$-in. brass treblet tube $1\frac{1}{2}$ in. long; if the inside isn't perfectly smooth, it can be made so in a very short time, by treatment on an improvised lap. Wrap a few turns of fine emery-cloth

around a wooden meat skewer (if such things haven't become extinct—they are hardly needed for the present size of the meat ration!) or a pencil would do. The roll should be a loose fit in the tube; grip it in the chuck, run the lathe as fast as possible, and run the tube up and down the improvised lap for half-a-minute or so. The result will be a smooth and true pump barrel. The ram need not be turned at all, if an easy sliding fit in the tube; all it needs is a packing groove. Slot the end for a $\frac{1}{4}$-in. lever.



Tender hand pump

The valve-box is machined up from a 1-in. length of $\frac{5}{16}$-in. bronze or gun-metal rod—brass will do at a pinch—the sizes being given in the drawing, and the method, the same as described for the larger pumps, and ordinary eccentric-driven pumps. The balls are 5/32-in. diameter, rustless steel or bronze, the delivery seatings being D-bitted $\frac{3}{16}$-in. and reamed $\frac{1}{8}$ in. and the suction seating formed on the bottom cap. The plug for connecting to barrel, is screwed into a tapped hole in the side of the valve-box ($\frac{3}{16}$ in. by 40) and the spigot pressed into the barrel. All joints may be soft-soldered, as there is no heat to withstand, and the solder is only needed to stop up any interstices. It is also quite strong enough to secure the barrel firmly to the stand. The whole assembly is shown in the section, and needs no further explanation.

The complete pump is installed in the water-tank, with the handle exactly under the centre of the filler hole, when the lever is vertical. Fix it down with four 6-B.A. screws through lugs and soleplate, nutted underneath. An elbow fitting, very similar to the one specified for the superheater, but having the end formed like a union screw, goes through a hole in the soleplate, a little ahead of the valve-box. This is held in position by a lock-nut on the union screw, which should be made about $\frac{5}{16}$ in. long for the purpose. The union is connected to the union on the pump, by a swan-neck of $\frac{1}{8}$-in. tube, with nuts and cones on each end, as shown in the section of the tender body. A $\frac{1}{8}$-in. pipe, with a couple of coils in it to provide the necessary flexibility between engine and tender, is connected to the elbow union, and terminates under the front beam in a $\frac{1}{4}$-in. by 26 union nut and cone, for attachment to the union on the engine. The pump is operated by the simple extension h ndle shown, worked through the filler hole; and the resistance at the end of a $4\frac{1}{2}$-in. extension handle, is practically negligible even with 80 lb. pressure in the boiler. I have used similar pumps for test pressures of 350 lb.

Buffers, couplings, steps, and any other trimmings can be "added to taste" as Mrs. Beeton would remark; and same applies to the engine, so I guess that no further space need be wasted on constructional notes. Instructions for the alternative oil-burner will appear, by kind permission of our friend the K.B.P., as soon as I can make the necessary drawing. The description of the "wee Dot like Doris" has been very much condensed, as there is hardly need to go into full detail, when I have already fully dealt with the $3\frac{1}{2}$-in. gauge engine; but if any beginner is at all hazy about how to machine and fit the various components, he has only to look up the equivalent part of "Tich." That engine is being very fully and completely detailed out, especially for beginners' benefit; but—don't laugh too much!—experienced builders of many years' standing have taken a liking to the tiny engine, and many of them are building one to keep her more elaborate and larger sisters company. One advertiser alone, has, at time of writing, sold over *four hundred sets*, and orders are still coming in!

Epilogue

Maybe I might do worse than conclude the tale with a hint or two on operation. Oil all the moving parts with any good motor or machine oil, and fill the lubricator about $\frac{3}{4}$ full with thick black cylinder oil of "superheater" grade, such as Cyltal 80S, Vacuum 600W, or similar grade. This is essential to protect the valves, faces, and bores from the effect of really hot steam. Fill the boiler with hot water until it runs out of the test-cock pipe; hot water saves spirit, and gets up steam more quickly. Shut the fuel valve, fill spirit tank about $\frac{3}{4}$ full of methylated spirit (what our old friend Bro. "Iron-wire" Alexander, one of the pioneers, used to call "spirits of wine") screw the filler-cap down tightly, and open the valve. Spirit will flow into the sump until it fills the burner tubes and covers the end of the air-pipe, when the flow will cease, only restarting when the pipe is uncovered, as the spirit is consumed by the burners.

If you have an auxiliary blower, either fan, tyre-pump, or any other kind, use it exactly the same as for a coal-fired engine; an induced rush of air past the burners, not only gets up steam in double-quick time, but "takes the poison out of the gas" by eliminating the emission of

(*Continued on page* 48)

IN THE WORKSHOP

by "Duplex"

54—Screwdrivers

ALTHOUGH the screwdriver is used as much as any tool in the small workshop, it often suffers from neglect and no particular attention is paid to maintaining its all-important working surfaces in good condition. When the tip is not correctly formed or has become worn out of shape, the screwdriver may tend to slip in the screw slot and thereby cause unsightly damage to the screw head ; moreover, if great restraining pressure has to be applied to prevent the screw-

Fig. 1. *Hollow-ground and straight-sided screwdriver blades*

driver rising in the screw slot, the muscular effort so applied detracts from the more essential turning effort. The more nearly parallel the sides of the tip, the less will it tend to rise in the screw slot, but, as this formation lessens the strength of the tool, a compromise is effected by shaping the blade with slightly hollow-ground side faces, as illustrated in Fig. 1A.

This form of tip is best suited for all ordinary work, but, where the greatest strength of blade is required, the shape depicted in Fig. 1B is commonly used.

In gunsmithing, for the sake of appearance quite large screws are made with a slot only 15 thousandths of an inch in width, and, as these screws are put home very tightly, an extremely strong screwdriver with a markedly wedge-shaped tip is required, and exceptional skill in its use is essential if damage to the screw heads is to be avoided. Much useful practical knowledge respecting screws and screwdrivers can be gained from dismantling a well-fitted gun.

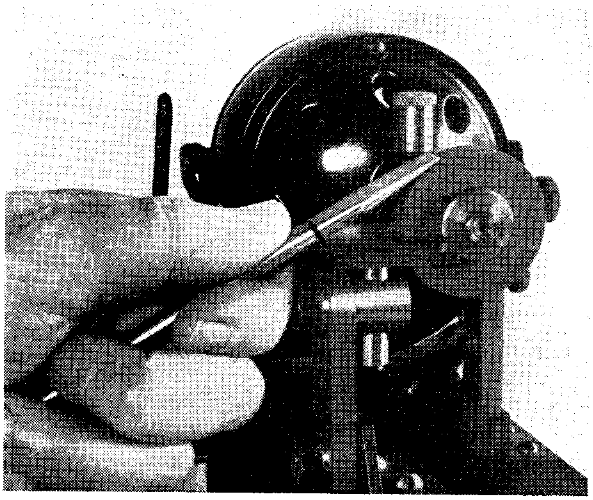


Fig. 2. *Showing method of applying the screwdriver to the grinding wheel*

Grinding Methods and Appliances

A method of grinding the screwdriver tip we commonly use is illustrated in the photograph, Fig. 2. The small grinding machine depicted consists of an electric fan motor with a 2 in. diameter India wheel mounted direct on the armature shaft. The series-wound motor is controlled by means of a variable series resistance and an adjustable brake-pad to prevent the machine racing when running light. The wheel is kept freely oiled, and, as a constant supply of oil is

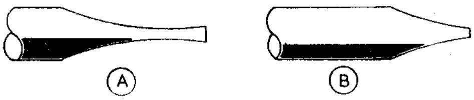


Fig. 3. *Showing effect of too much and too little projection of the blade when grinding*

thrown outwards by centrifugal force towards the periphery of the wheel, there is but little danger of the work becoming overheated.

To grind the blade to the form shown in Fig. 1A, the extreme edge of the tip is positioned on the centre-line of the wheel and with the long axis of the blade at right-angles to this line.

A line to act as a grinding mark is then drawn with a grease pencil right round the blade at the point where it meets the edge of the grinding rest. It is essential to position the blade correctly in relation to the wheel, for, if advanced too far, the tip will be given the contour shown in Fig. 3A, and, if not far enough, the result will be as depicted in Fig. 3B.

To obtain a perfectly evenly ground blade in this way, requires some little dexterity, and it was, therefore decided, to design a grinding jig which would automatically produce a properly ground blade either of the hollow-ground form, or with a slightly wedge-shaped tip having flat sides.

The general arrangement of the jig is shown in Fig. 4, and Fig. 5 illustrates how the appliance is used to present

the screwdriver correctly to the periphery of the wheel in order to obtain the hollow-ground effect; in addition, the inset drawing in Fig. 4 shows the way the screwdriver is mounted in the holder when forming the flat sides of a wedge-shaped tip.

The essential parts of the device are: a table which is attached to the upper end of the pillar carrying the ordinary grinding rest: an adjustable angular fence and guide bar secured to the table, and a carrier for the screwdriver itself, consisting of a block with two vee-guide channels and a central cross-drilled clamping-bolt to hold the blade securely in position.

It will be seen in Fig. 5 that, as in the previous example, the extreme edge of the blade is positioned on the periphery of the wheel, so that the shank of the screwdriver lies at right-angles to the line joining the point of contact to the centre of the wheel; that is to say, the blade is set tangentially to the circumference of the wheel.

The actual height of the rest is immaterial except for convenience in operating, for it will be clear that the correct grinding position is obtained by setting the screwdriver blade to project for the right distance from the vee-block in which the tool is secured.

A grinding wheel 4 in., or so, in diameter, will give a sufficient hollow-ground effect for screwdrivers of medium size, without unduly weakening the tip of the blade; but the grinder, previously described, with a 2-in. diameter wheel will be found especially useful for forming the tips of small screwdrivers.

The tools known as jewellers' screwdrivers, and used for watch and clock making and small instrument work, have their hollow-ground tips formed to a still smaller radius, so that a grinding wheel of 1 in. diameter, or less, will give the correct curvature to the blade.

Should a blade of the flat-sided wedge form, as shown in Fig. 1B, have to be ground, then the screwdriver is secured in the vee-block in the position illustrated in the inset drawing in Fig. 4 and the slope of the sides of the blade is set by adjusting the fence with its guide rail to the angle required.

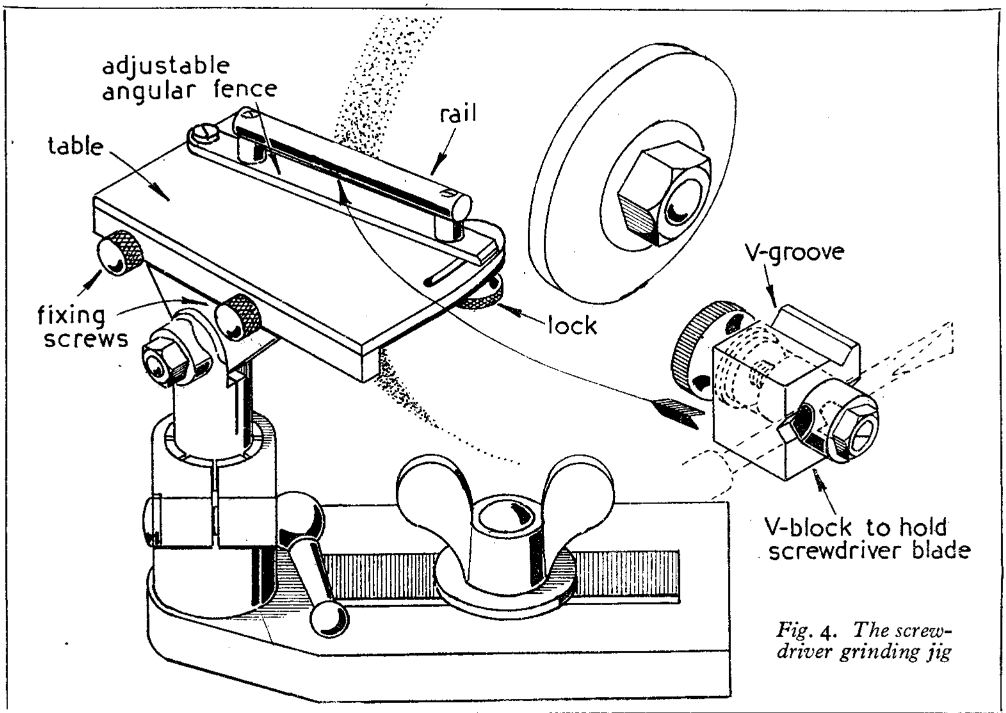


Fig. 4. The screwdriver grinding jig

When grinding blades in either of these ways, the screwdriver, once it has been clamped in position, is not moved in the holder until both sides of the tip have been ground; moreover, the symmetrical form of the vee-block will ensure that the angles or curvatures formed are similar on the two sides of the blade, and it is only necessary to control the depth to which the grinding is carried to obtain the desired result.

When it comes to making the jig, there are some points in the construction and machining which may, with advantage, perhaps, be described in detail.

The Table

It will be seen that the table, illustrated in the drawings, is designed to be attached by pointed finger-screws to a bracket fitted to the column which normally carries the grinding table of the machine. This mode of construction can, however, be simplified if the table in question

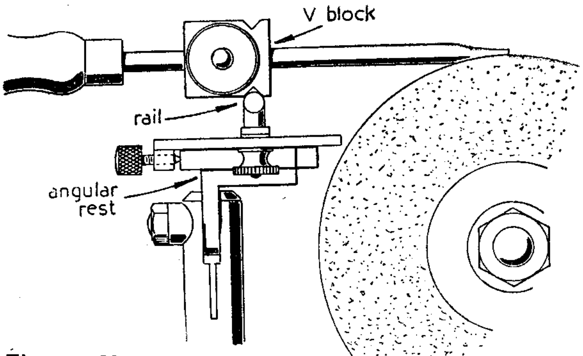


Fig. 5. Showing the position of the screwdriver on the grinding wheel

is attached to the ordinary grinding table by means of two countersunk screws, or is merely clamped in place by using two small toolmakers' clamps.

It will be appreciated that the table, here shown, was made for use with a particular grinding machine, but it may be found necessary to modify the design to suit other machines of different construction. In any case, the important feature, the adjustable angular fence and its guide rail, should be fitted as shown in the drawings.

The curved slot formed in the table must allow the guide rail to be set in a position at right-angles to the wheel axis, and, at the same time, the length of the slot in the forward direction must be sufficient to enable the screwdriver blade to be ground to the correct wedge form when applied to the side of the wheel.

The Vee-block

As already mentioned, when the vee-block is accurately made it will ensure that the two sides of the screwdriver blade are symmetrically ground. It is essential, therefore, that not only must the hole for the clamp-bolt be bored centrally, but the two vee-guide grooves must also be machined to an exactly equal depth.

The block itself is made from a length of 1-in. square mild-steel which, after its centre has been marked out and centre-drilled, is mounted in the four-jaw chuck with the centre-mark set to run truly with the aid of the centre-finder.

The bore to accommodate the clamp-bolt is drilled, bored, and finally reamed to size. The next operation is to machine the two vee-grooves for guiding the block on the rail. For this purpose, the block is either clamped in the top slide toolpost of the lathe, or is secured in the machine vice attached to the vertical slide. The block is set truly at right-angles to the lathe axis by means of a rule or parallel strip in contact with the chuck face, and, at the same time, the centre-line of the vee-groove scribed across the block is set to the centre height of the lathe.

The vee-grooves can quite well be machined with a sharp 90 deg. countersink, preferably,

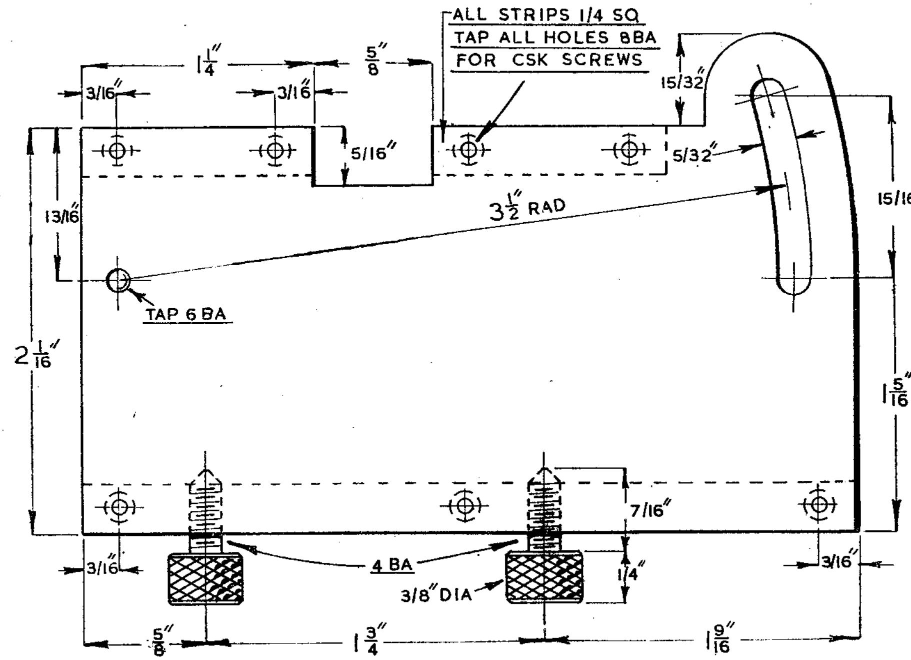


Fig. 6. The table and its fixing screws

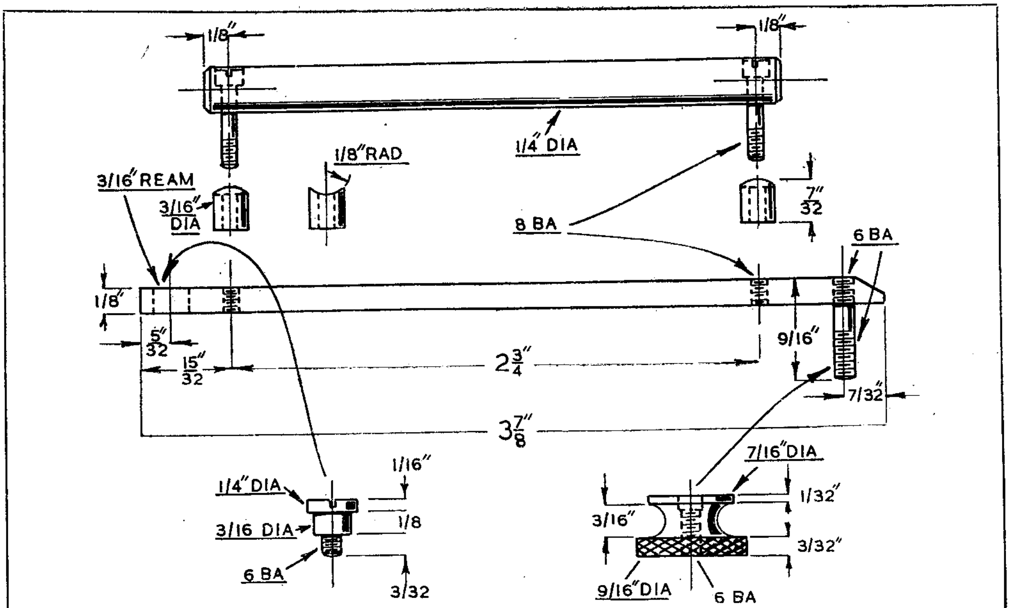


Fig. 7. The adjustable angular fence and guide rail

having four cutting lips. When the first groove has been cut to the required depth, the reading of the leadscrew index is noted and the block is then rotated through 180 deg. and realigned with the chuck face.

The second groove can now be machined to the correct depth by reference to the leadscrew index. After the block has been reset with the centre-line of the bore at lathe centre height, the vee-groove in which the blade of the screwdriver lies is machined in a similar manner.

The piece of material used for the clamp-bolt is turned to the dimensions given in Fig. 8, and is then reversed and centred in the four-jaw chuck for drilling and tapping the hole to receive the forked pressure-pad. Finally, the part is set up in the four-jaw chuck for drilling and boring the $\frac{7}{16}$ in. diameter cross-hole on the centre-line. To complete the component, the pressure-pad is fitted in place and secured with a lock-nut.

When making this pad, the vee-groove in its end can be formed by filing or, if preferred, it

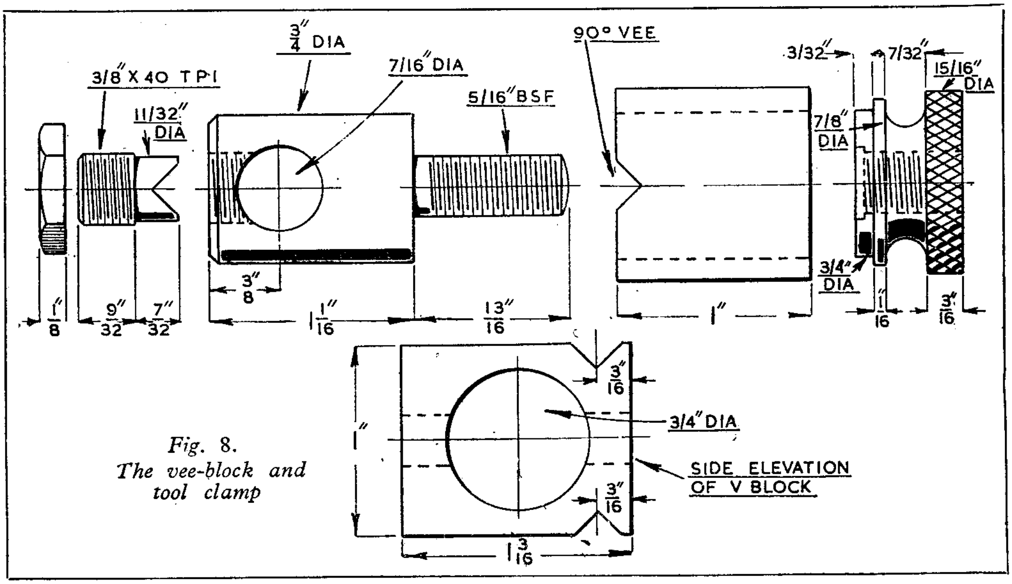


Fig. 8.
The vee-block and tool clamp

can be machined in the same way as the other vee-grooves in the block. It will be clear that, when the knurled finger-nut is tightened, the central bolt will be drawn inwards, thus securely clamping the screwdriver blade between the pad-piece and the vee-groove formed in the end of the block; furthermore, the pad-piece itself can be adjusted to accommodate blades of various diameters.

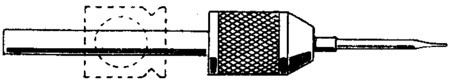


Fig. 9. A chuck used to mount a small blade in the vee-block

Holders for Small Blades

Some small screwdrivers are furnished with detachable blades which are too short to provide the necessary overhang when secured in the vee-block. In this case, as represented in Fig. 9, the blade is mounted in a holder or chuck which, in turn, is clamped in the vee-block; but a carrier such as the "Eclipse" pin vice will be found less cumbersome for mounting blades up to $\frac{3}{16}$ in. in diameter.

An alternative method of holding small round blades is to use an appliance similar to that illustrated in Fig. 10. This holder can be made from a length of, say, $\frac{5}{16}$-in. diameter round mild-steel, and the end of the shank is knurled to afford a better finger-hold. The rod is drilled axially to fit the screwdriver blade, and a piece of steel to carry a binding-screw is silver-soldered to the front end. Whenever carriers, of the forms described, are used for holding small blades, it is important that the blade should overhang the holder for as short a distance as possible in order to maintain rigidity and avoid springing when the tip is being ground.

The Grinding Operation

With regard to the actual grinding operation, when hollow-grinding on the periphery of the wheel is carried out, the screwdriver blade is placed opposite the centre of the wheel and the handle is raised with the right hand until light contact is established; the left hand, meanwhile, holds the vee-block firmly down on the guide rail. Grinding should be continued for a few seconds at a time only, otherwise there is a danger of drawing the temper of the blade. Grind first one side of the blade and then the other to keep the tip symmetrical. Examine the faces from time to time, and try the blade in a standard screw slot, or one of a width commonly used, until it is found that a good fit in the screw head has been obtained. If the work has been properly carried out, the hollow-ground faces should appear as smooth continuous curves quite free from ridges or other blemishes.

When grinding the blade with flat faces by using the side of the wheel, the blade is pressed lightly against the wheel for a few seconds and, at the same time, the handle is alternately raised and lowered to keep the work moving. This method of grinding has the disadvantage that the scratch lines formed by the wheel run across the blade and in the direction in which the blade is stressed when in use; this renders a hardened tip more prone to fracture than when the grinding lines lie in the direction of the long axis of the blade.

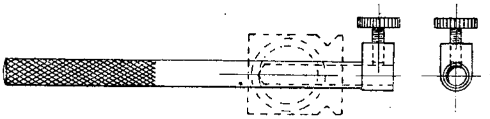


Fig. 10. A holder for small blades

Apart from grinding the sides of the blade, the front face, as the result of wear, may need truing. This can be carried out accurately by withdrawing the blade in the vee-block so that the front edge comes into contact with the wheel and at right-angles to it. To avoid a dig-in, however, it is essential that the blade should be supported close to its tip against the front edge of the table, and, at the same time the screwdriver handle must be held firmly.

"L.B.S.C."

(*Continued from page* 43)

unburnt spirit vapour, which is the stuff that makes your eyes smart. If you haven't a blower, take off the front of the smokebox until there is enough steam to work the engine's own blower; then open the valve, and replace the front. Warning: keep the blower on a little, all the time the engine is standing, and *always* open it before shutting the regulator; if you don't, flames will come out from under the firebox casing. When there is about 50 lb. on the gauge, give her a run "light," to warm up. Steam will work up to blowing-off point whilst doing this; then couple up your twenty coaches, kiddy car, or whatever you want the "wee Dot" to pull, and she will oblige, without hesitation. A few strokes of the hand pump every few minutes, will maintain water level. Beginners who have had no experience of loose eccentric valve-gear, should remember that to reverse the engine, it is necessary to move her half-a-turn in the required direction. Once set, she will continue to run that way, until reversed by hand again. The lubricator valve should be opened from half to three-quarters of a turn; an oily ring at the chimney top is a sure sign that all is well down below. With that, I'll leave you to it!

Hand-Turning Tools

by "Scotia"

THE following notes are written with the object of bringing to the notice of readers the use of hand-turning tools in the lathe. It is felt that, so much has been written describing the turning and forming tools for use in the tool-post, that the possibilities of using hand-turning tools are apt to be overlooked.

Their use, of course, is limited to brass and possibly a few other alloys, such as dural, etc., which are of a soft nature. Since the early days

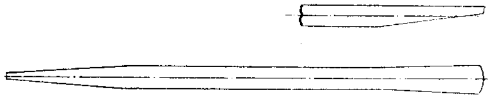


FIG. 4 ROUND NOSED TOOLS

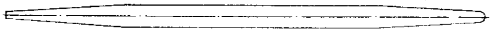


FIG. 5

of the lathe in its most primitive form, work of a very high standard indeed has been carried out on it. Especially was this so in the case of ornamental or figured work, and it is a sobering thought indeed to realise that there are not many artisans left of this calibre, to carry on this exquisite work. Indeed, if put to the test, it is doubtful if any of us could equal the very fine hand-turned work carried out by the pioneers of the lathe.

On the early brass-finisher's lathe, the T-rest was in use long before the compound slide appeared, and this fact, no doubt, led to the high standard achieved with hand-turning tools. It must indeed have been a pleasure and a privilege to watch these men at work, especially when one considers some of the difficulties encountered at that time. There was a time, for instance, when chucks, as we know them today, did not exist, and a sort of lead chuck was used. This

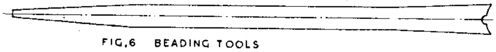


FIG. 6 BEADING TOOLS

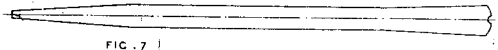


FIG. 7

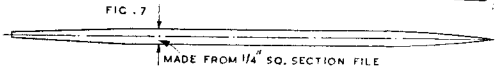


FIG. 8 SCRAPER

consisted of a flanged piece of lead attached to the mandrel, the outer edges of which were hammered over the work-piece till the latter was securely "imprisoned"; it was then trued up and the protruding part turned. Difficulties like this were commonplace to these men, and

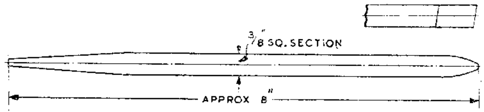


FIG. 1 ROUGHER

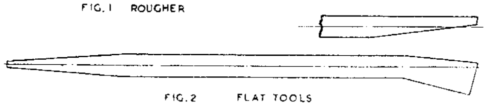


FIG. 2 FLAT TOOLS

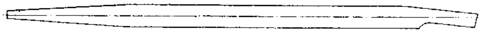


FIG. 3

overcoming them was taken for granted, success being the rule rather than the exception.

It is proposed to comment on a few of the tools used, and Fig. 1 shows a slim round-nose hand-tool known as the "rougher" or "ripper," its purpose being to tackle the rough outside skin of the casting. Applied in a very firm and confident manner and by dint of movement of the wrists, the tool is manoeuvred in the direction required. It will be realised that this tool, perhaps more than any other, is the most obsolete of them all. Figs. 2 and 3 show ordinary flat hand-tools, a narrow and a broad one respectively. Figs. 4 and 5 are round-nosed tools for shaping, while Figs. 6 and 7 show a type of beading tool sometimes used. Fig. 6 has a radius ground on each side of the groove to suit a convex surface, while that of Fig. 7 is ground the opposite way to suit a concave surface. Fig. 8 shows a scraper, which is used exclusively for the bore. This is usually made from an old square file of about $\frac{1}{4}$-in. section, all serrations being ground away. This is an excellent little tool, provided the user bears

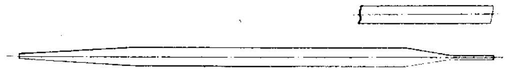


FIG. 9 PARTING-OFF TOOL

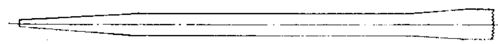


FIG. 10 COMB OR CHASER

in mind that it is meant only to remove the last few thous. in the bore.

Used in the correct manner, this will, at the same time, impart a beautiful finish. A natural impulse with beginners is to expect too much from this little tool and apply it in such a manner, as would suggest that they mean to remove at least 1 lb. of metal at one go. The little scraper immediately protests at such treatment, and in defence will set up a chatter and oscillation in the bore which might be difficult enough to remove. Fig. 9 shows a thin, narrow tool, used for parting-off, and like Fig. 1 is now almost forgotten.

The handling of these tools is all a matter of experience, and no amount of written instruction can ever equal a spot of practical work.

There are some generalities which can be applied, however, and the placing of the T-rest at just a short distance from the job is essential. Regarding the height, centre or a shade lower is

ideal. The tools themselves should be kept sharp, and the edges of finishing ones rubbed down on the oilstone—as a correctly honed edge imparts a beautiful finish to the job.

The natural grip when using these tools is to have one or two fingers of the left hand round the upright part of the T-rest, and the thumb over the tool itself, the right hand holding the wooden handle into which the tool is firmly fixed. As to the manner of application, it is often found an advantage to dip the handle of the tool, thus presenting the edge of the tool tangential to the work, the point of contact being approximately between the T-rest and top diameter of the work-piece. Especially is this applicable when a fine finish is desired towards the completion of a job.

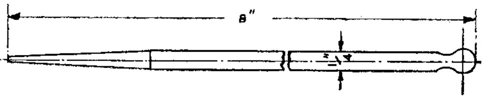


FIG. 11 BURNISHING TOOL

Assuming that the work is of an ornamental nature, very often chatter is encountered and careful handling of the tools is essential to remove this. The removal of these unseemly blemishes cannot be accomplished by any set formula, and no one can say with any surety, that they will remove them by this or that method. I have seen the successful removal of chatter, following the simple expedient of oiling the bearings of the lathe. This is, of course, more of a freak cure than anything else, and illustrates the vagaries connected with working on an old lathe with worn bearings.

However, the worker of experience has no need to panic, and removal of the marks can be accomplished by his own particular methods.

It may be by applying just the correct amount of pressure with the hand-tool at a particular angle, or simply by reducing the speed of the lathe.

Generally speaking, chatter marks cannot be removed by using a broad hand-tool in an indiscriminate manner.

A very small part of edge must be applied to the area, and coincident with removal of the marks, an attempt made to blend the affected part into the rest of the design.

Where a figured design is rather thin, owing to a hollow interior, the chatter can often be overcome by packing the inside tightly with waste or rags. In any case, it is often unwise to try to remove indentations of this nature by rubbing with emery-cloth, as this has the effect of rounding off any sharply defined figurework which may be required to be retained.

A tip to beginners—if the design or figurework is of simple character, and is balanced, e.g., the same on either side of central part, it is advisable to turn, or otherwise mark the position of central part first. In this way only, is one sure that the work will not have a lop-sided appearance.

Deftness of hand and aptitude for overcoming difficulties only come with experience, however, and in consequence, the worker must not be discouraged if he feels his first attempt is fraught with insurmountable difficulties.

Perhaps it may be of interest to remark on the hand-burnisher, shown at Fig. 11. This is a hand-tool with a ball-like top to it, which must be kept in a highly polished state, resembling very closely the tools used by copper-spinners and working on the same principle. I have seen it used for "burnishing in" the "hot" and "cold" porcelain discs on the capstan heads of taps. This tool has to be used with care to guard against accident by slipping.

It may be of interest to remark in passing that an excellent finish can be given with this tool to any part of a casting held in the vice, which may be inaccessible to the polishing dolly.

The hand-knurling tool shown at Fig. 12 is one which is fairly familiar to readers, but it may not be generally known that it can be used to a limited extent for decorative purposes, and is very effective. In the case of this, however, and the burnishing tool just mentioned it may be possible to hold them in a fixed toolpost, thereby cutting out to a great extent the risk of accident by slipping.

We might break off here and turn to the method of screw-cutting in a plain lathe.

It was at one time quite a common practice for brass finishers to "strike" the thread required with a hand-comb or chaser, and by careful "chasing" bring it up to correct pitch and diameter. The whole secret in this is judging the speed of the lathe in relation to the required number of threads per inch. and applying the "chaser" in the correct manner. The tool is held firmly in both hands, but a pliable movement of the wrists is necessary to make contact at the appropriate speed. It is very easy to make a

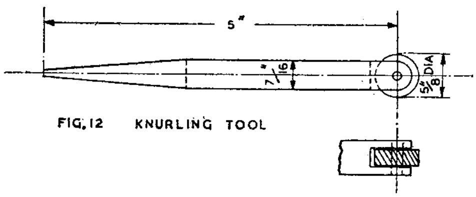
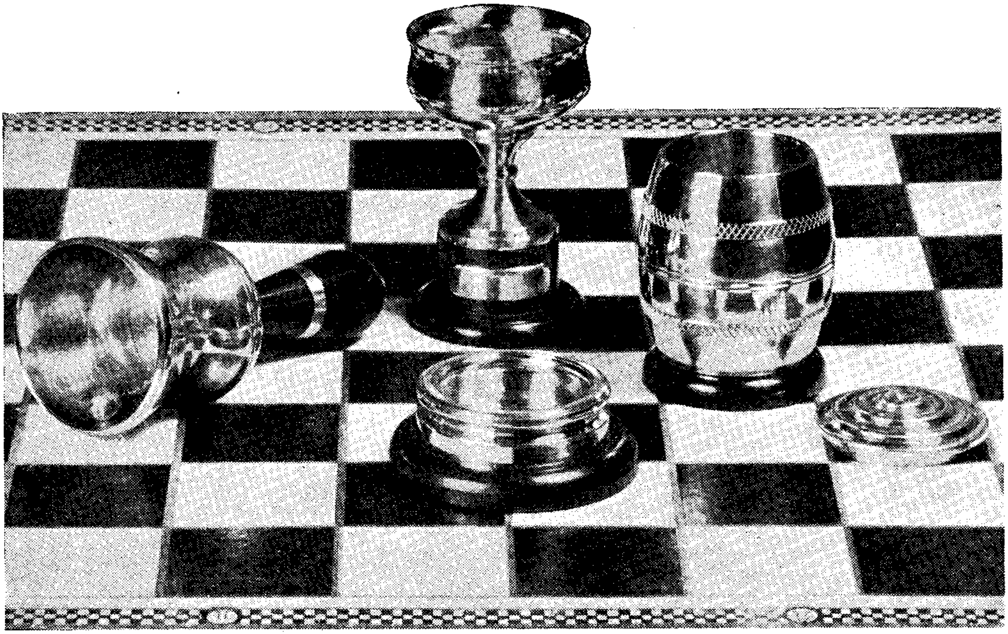


FIG. 12 KNURLING TOOL

"drunk" thread, which apt description explains itself, I am sure. Practice makes perfect, however, and generally speaking the finer the thread the easier it is to strike. I have struck internal and external threads, on parts which had to be interchangeable, very successfully. If preference is for the diameter to be larger than required when starting, care must be taken to see that whenever the full thread is formed, the top of the thread must be made flat again by means of the hand tool, the chaser then being applied to bring it up full once more, and so on.

If the chaser is used persistently on a fully formed thread for the purpose of reducing the diameter, it is almost certain to chatter and knurl, and might even appear to go drunk!

When making small cocks, etc., for model work which call for 40 t.p.i. on $\frac{1}{4}$ in. or $\frac{3}{16}$ in. diameter, I use nothing other than a chaser to strike them. The degree of accuracy achieved



can be gauged by the fact that I can get them a perfect and true fit, finding by checking with the micrometer that they are invariably only minus 0.001 or perhaps 0.002 in. on diameter, which is normal tolerance.

In conclusion, I would say that there is something to be said for the use of hand-turning tools in the lathe and if a T-rest or a plain bar rest from the saddle can be rigged up, they are well worth trying out.

Used in conjunction with the fixed tools in the lathe, they are ideal, and the proper use and application of them is an education in itself, affording the worker much satisfaction and a sense of achievement rarely equalled in other spheres of model work.

The examples shown in the photograph (taken by Wm. Bell) were done on a 5 in. lathe, a T-rest being used for the hand-turning required.

I would be glad to hear from anyone interested and give help wherever possible if they would write c/o the Editor.

For the Bookshelf

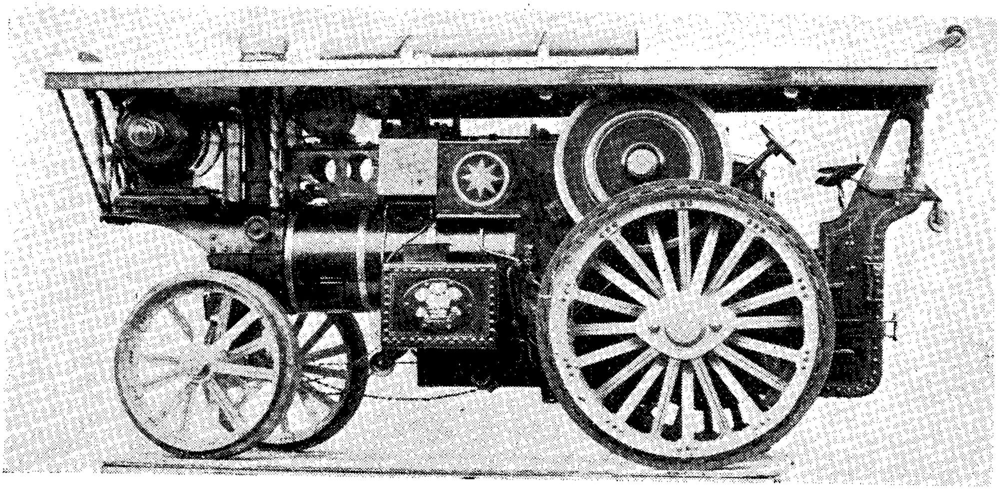
Electrical Timekeeping. (Enlarged second edition.) By F. Hope-Jones. (London: N.A.G. Press Ltd., 226, Latymer Court, W.6.) Price 21s.

Some time ago we reviewed *Electric Clocks and How to Make Them* by the above author, who is a famous specialist in this branch of horology, and has written several authoritative books on the subject. The present work is a completely revised and enlarged edition of a well known earlier book, and deals with the subject in much greater detail, also from a different aspect from that mentioned above. It begins by reviewing the history and development of time-measuring mechanism, and the introduction of electrical motive power in various forms. The "remontoire" or self-winding type of clock, in which electricity is applied as a means of restoring the power of a weight or spring in clocks which work on normal mechanical principles; impulse clocks, in which the pendulum or balance is electrically sustained, and acts either as a motor to drive the dial indicating mechanism, or to control electric contacts at accurately timed intervals, for driving secondary dials; and synchronous clocks, which utilise the closely-controlled periodicity of alternating current mains to transmit the rate of a master clock to secondary dials, are all dealt with in turn.

The section of the book dealing with the adaptation of the gravity or constant-impulse pendulum principle to electric clocks, and its ultimate development, the free pendulum, is given the prominence it deserves, and details are given of the part which electric clocks have played in rendering possible a national time service, through the grid system of a.c. electric supply, radio time signals, etc. A chapter is devoted to the quartz crystal or "piezo-electric" clock, in which control of high-frequency currents supersedes the pendulum or balance. It can be said that this book is one of the most comprehensive treatises on the science of time measurement which has ever been written, and may be regarded as indispensable to the serious student of horology.

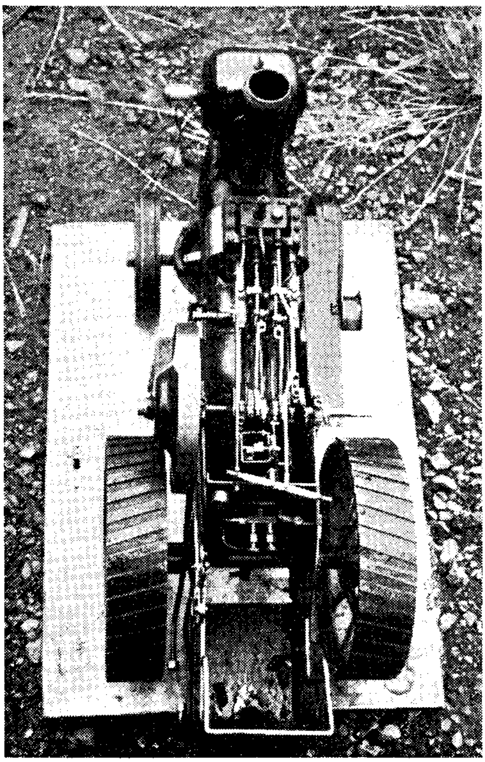
A $1\frac{1}{4}$-in. Scale Showman's Engine

by G. Thomas



THIS engine is built to $1\frac{1}{4}$-in. scale from measurements taken from the full-size, and is a compound: bores, $\frac{3}{4}$ in. H.P., $1\frac{1}{8}$ in., L.P. and $1\frac{1}{4}$ in. stroke. The boiler is $3\frac{3}{8}$ in. diameter with eleven $\frac{3}{8}$ in. tubes, the working pressure is 85 lb. per sq. in. and makes ample steam, being pumped and injector fed; the water is just behind the belly-tank for easy access. The oil-pump can be seen by the steering-wheel, put there for the same reasons, like the water-pump.

Two dynamos light up ten lamps under the canopy at about 180 r.p.m. The front and rear wheel rims were cut from $\frac{1}{16}$-in. and $\frac{1}{8}$-in. sheet-iron rolled and welded; the T-rings were turned on the face-plate from sheet, knocked in and sweated. The treads are riveted on with rubber tyres outside. Minus tyres, the wheels are $5\frac{5}{8}$ in. and $8\frac{1}{8}$ in. diameter. The cylinder-block is offset from the boiler centre to accommodate a Burrell 3-speed gear; but the full-size engine had been built in with corrugated iron when I went to check up, so a 2-speed was fitted instead.



The engine works very well, both generating and on the road, and has hauled approximately 35 stone in bottom gear; she runs at a good walking pace in top gear. She is painted maroon, with blue and cream lines; the wheels are cream with red and blue lines and rivets. The badge on the tank is from a Welsh regiment, and the engine has been christened *Pride of Wales*.

The time taken to complete the model Burrell was $2\frac{1}{2}$ years, as indicated by her number on the front, 1944-1947.

Another photograph of the engine is shown on the cover of this issue.

A bird's-eye view on this page is of my $1\frac{1}{4}$-in. Fowler "Big Lion" which may be of interest to others, a description of which will be forthcoming at a later date.

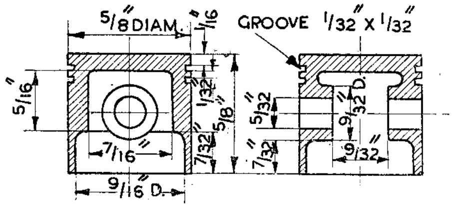
*UTILITY STEAM ENGINES

by Edgar T. Westbury

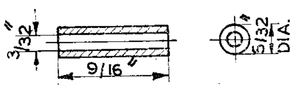
THE four holes in each of the end flanges of the cylinders should be carefully marked out, so as to be equally spaced, and on the same pitch circle diameter. A very sound method of ensuring this, is to use a drilling spindle in the lathe, in conjunction with some method of indexing the lathe mandrel in four positions. If the flanges have already been squared, it will be necessary to locate the holes relatively to the corners, but it will probably be found easier to drill the holes first, and locate the edges of the flanges from them.

It will be seen that two fairly deep grooves are formed in the piston near the head end ; these may be used as ring grooves if desired, but even if no rings are fitted, they will form useful oil-retaining grooves, and also act as labyrinth packing. Two or three grooves near the skirt of the piston are also desirable, but as the wall is thin at this end, they cannot be made very deep. They will, however, serve a useful purpose, even if they are no more than mere scratches on the surface.

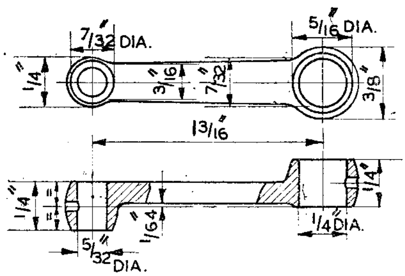
The pistons should be turned to within about 0.001 in. of finished size, and a ring lap used to reduce them just sufficiently to slide stiffly in the cylinder bores, after which they may be bedded in to a working fit with plenty of oil and a trace of polishing paste or similar fine abrasive. It is advisable to drill the gudgeon-pin holes before lapping the pistons, as some slight distortion may take place when they are drilled. Take care to get the gudgeon-pins dead square with the axis of the pistons, using the methods which have been described in previous articles, as referred to above.



Sections of the pistons



Gudgeon-pin



Connecting-rod. (2 *off bronze*)

To locate the tapping holes in the crankcase for the cylinder fixing-screws or studs, the cylinders may be used as jigs, by securing one or both of them in place by means of a long bolt passed right through the crankcase, with a plate or disc bearing on the cylinder ends. The drill will pass through both flanges of the cylinder for spotting the position of the tapping holes. A similar method of procedure may be used when locating the tapping holes in the cylinder-heads.

Pistons

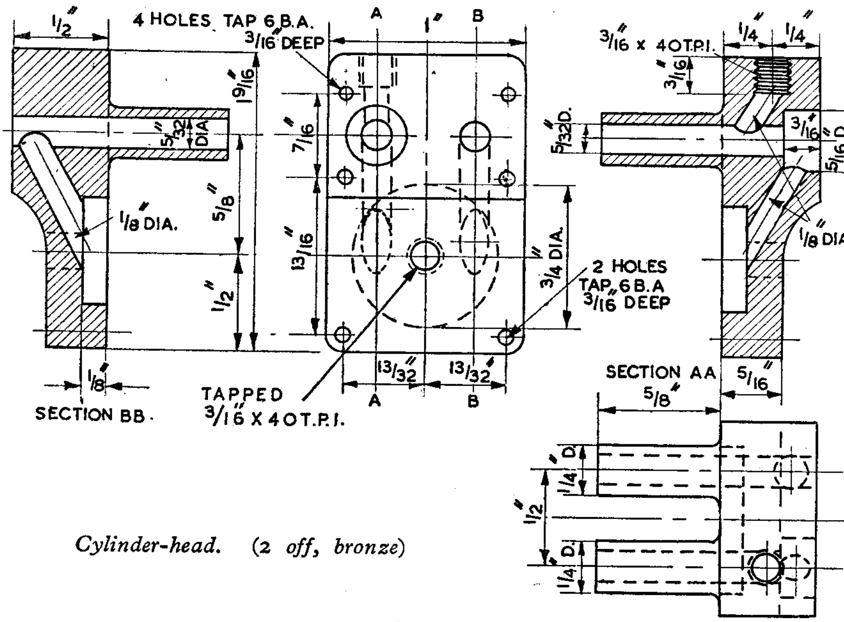
These may be made in the same way as described for the pistons of the "Spartan" and other single-acting engines. It is hardly practicable to obtain accurate iron castings for pistons of this size, and cast-iron or steel are the only practicable materials for a steam engine of this type, the former being much the better of the two. In either case, it is necessary to machine the pistons completely from the solid ; although the milling of the inside to form the gudgeon-pin bosses is often regarded as a formidable operation, many constructors have found it less difficult than it sounds, and the desirability of reducing the weight of the pistons, as much as possible, will be appreciated.

If it is decided to use piston rings, it is suggested that they are made from phosphor bronze—and in this case I do mean phosphor bronze, which has greater hardness and elasticity than most other alloys in this class. The radial thickness of the ring should not be more than 0.030 in., and the initial size, before splitting, not more than 0.020 in. larger than the cylinder bore. Many small piston rings, even those professionally made, are much too stiff in section, and too much oversize, which not only increases the risk of distorting or breaking them in getting them on or off, but also causes far too much working friction. Cast-iron rings are best, but it is very difficult to get sufficiently fine-grained and homogeneous material, and they are very fragile in so small a size. Do not forget that fit and finish of the sides of the rings are just as important as on the circumference. Incidentally, it would

**Continued from page* 838, *Vol.* 101, "*M.E.*," *December* 29, 1949.

be possible to use soft packing for the pistons of this engine, by turning one wide groove instead of the two narrow ones, and allowing greater thickness of wall at this point so that the groove can be made not less than $\frac{1}{16}$ in. deep; but packing of this kind is not recommended for engines intended to work on high temperature superheated steam.

The gudgeon-pins may be made from 5/32-in. mild-steel rod, drilled 3/32 in. through the centre and parted off, then case-hardened and polished. They are intended to fit tightly in the piston-pin bosses, which should, therefore, be finished on the tight side; if, however, they are made a floating fit, the ends should be fitted with brass pads to prevent the risk of scoring the cylinder wall.



Cylinder-head. (2 *off*, *bronze*)

Connecting-Rods

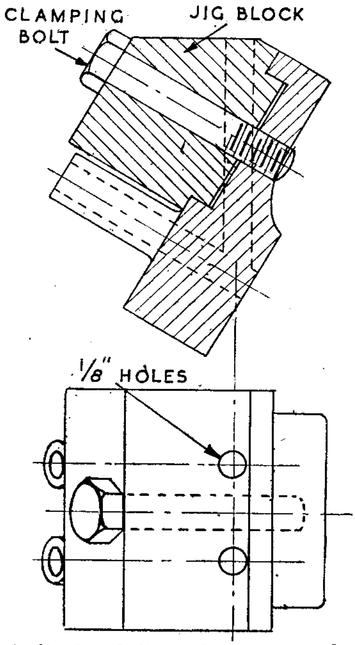
Bronze castings are recommended, though they may be made from the solid if preferred, in which case duralumin bar may be used, enabling the weight to be reduced without loss of strength. In the latter case, rough shaping of the rods, before boring the eyes, may be carried out by any convenient method.

It is important that the two rods should be exactly alike, particularly in respect of the distance between the centres of the eyes. They may be held in the four-jaw chuck to drill and bore the big-end, taking precautions to set the face of the rod square with the lathe axis. At the same setting the face and the outside of the boss may be machined. For dealing with the little-end eyes, remove one jaw of the chuck, and in its place, fit a tee-bolt, the head of which is accurately shaped to engage the groove in which the jaw slides, and the shank a close fit in the bore of the big-end. A distance bush, faced truly on both ends, is interposed between the eye of the rod and the chuck face, to pack the rod out to a convenient position for machining. After fitting the rod to the tee-bolt, and roughly centring the little-end eye, the remaining three chuck jaws are used to hold this eye and locate it truly central, with the assurance that when it is bored, it will be truly parallel with the big-end.

In case one should be tempted to regard these methods as too elaborate and irksome, it may be mentioned that in an engine of somewhat similar type made by a friend, an attempt was made to save time by holding the rods in a machine vice (before shaping the sides) and drilling both ends at one setting in a drilling machine. Theoretically, this should have ensured true parallelism of the eyes; but on testing them with mandrels inserted in each, a very considerable error was found in both planes, and moreover, the two rods were different in length between eye centres, despite careful marking-out. In order to make an engine work with rods machined in this way, the eyes would have to be made a very sloppy fit, which is not only bad workmanship, but also bad for lubrication and mechanical efficiency. I know that engines *can* be made to work more or less successfully by much cruder methods than I describe, and some constructors are quite satisfied with them; but my aim is to show readers how to make them to produce the very highest possible mechanical efficiency, and to keep on doing so after the other engines are worn out or broken down. Many readers know of easier methods or short cuts in construction, but it is no fault of mine if they fail to attain the result which the design is intended to produce.

In my experimental engine, the cylinder-

heads were fabricated, with inserted valve guides and seatings, but construction is greatly facilitated by using a single-piece bronze casting. Incidentally, it may be mentioned that the use of a heat-resisting aluminium alloy is being tried out for these heads, though the valve-guides and seatings are of bronze ; but it is too early yet to say whether this experiment is a complete success.



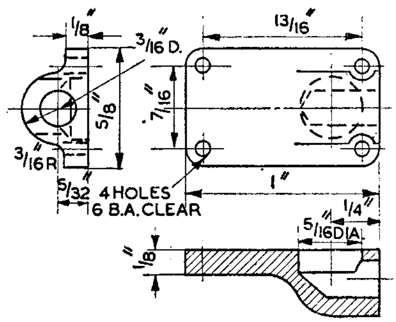
A simple jig for drilling the steam and exhaust passages in the cylinder-heads

The casting may be held in the four-jaw chuck for facing the joint surface as far as the valve-guides will allow, and machining the recess. Although not specified in the general arrangement drawings, it is advisable to drill a central hole in the head at this setting, for fitting a drain tap to prevent water-locking of the engine when starting, to which engines of this type are more liable than slide-valve engines. It will be found that the corners of the outer joint face cannot be faced by plain turning ; if the means are available, they may be end-milled, while still set up in the chuck, but a simpler, if somewhat more tedious method, is to turn the lathe by hand for as great a portion of the circle as possible, feeding the facing tool outwards each time until the corners are reached. This part should, if anything, be slightly undercut, leaving a ring around the recess to ensure a truly fitting joint. The casting may then be reversed in the chuck to face the joint surface of the valve-chest, using a parallel block of metal behind the already machined face, and bedding it firmlv against this to ensure that these faces are parallel.

The holes for attaching the head to the cylinder may now be drilled and tapped, using the cylinder as a jig as described above. Secure the head to the cylinder, and the cylinder to the crankcase, and locate the centres of the valve-guides exactly in line with the tappet bores. A special pilot-drill may be made for this purpose by turning the end of a piece of $\frac{1}{4}$-in. silver-steel rod to an angle of 60 deg., filing it flat for a distance of about $\frac{1}{4}$ in. and about $\frac{1}{16}$ in. thick, forming cutting edges on the angular sides, and hardening in oil. Each cylinder is, of course, dealt with in turn, the drill being passed through both tappets, and rotated either in the lathe, drilling machine or hand brace, to produce deep indentations in the end faces of the valve-guides.

The heads are then removed from the cylinders and set up, preferably on the faceplate, but the four-jaw chuck may be used as an alternative, provided that squareness of the joint faces can be assured. Centre each of the valve-guides truly in turn, start the hole with a centre-drill, follow up with a No. 25 drill and finish with a 5/32-in. reamer or D-bit. At the same setting, the outside of the guide should be turned, and this will call for a special tool, like an " inverted " boring tool, narrow enough to pass between the two guides without fouling. I made one quite easily by filing up the end of a piece of $\frac{1}{4}$-in. square silver-steel, narrowing it to $\frac{1}{8}$ in. behind the cutting edge, but retaining the full depth for strength. Of course, a $\frac{1}{4}$-in. hollow mill would be a still more suitable tool for the job, but would be more difficult to make, and it is hardly the sort of thing the amateur is likely to have around.

It will be seen that the exhaust valve has the outer end of the bore recessed or counterbored $\frac{5}{16}$ in. diameter for a depth of $\frac{3}{16}$ in., which may be done by holding the valve-guide in the three-jaw



Valve cover. (2 *off, bronze*)

chuck (it is possible to do this in a small chuck without the other guide fouling the jaws), entering a $\frac{5}{16}$-in. drill from the tailstock, followed by a flat-ended drill, D-bit or end-mill. Although it does not matter which valve is for steam admission and which for exhaust (so long as the cams are arranged accordingly), it is more convenient to fit the steam pipe at the timing end of the engine ; in any case the heads will have to be right- and left-handed, so that the two steam admission-valves are operated by one cam, and the two exhaust valves by the other. The formation of the valve seatings, and

(*Continued on page* 57)

Novices' Corner

Some Lathe Hints

WHEN screwing a chuck, or for that matter any other fitting, on to the mandrel nose, make sure that the threads on the nose are quite clean and well oiled in order to reduce wear. If the chuck has previously screwed home under moderate pressure and now sticks, it is probable that there are some chips adhering to the chuck threads, and the chuck must then on no account be forced on. The threads can readily be cleared by using a tool of the form shown in Fig. 1, made,

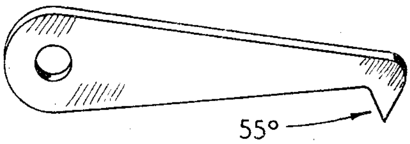


Fig. 1. Tool for cleaning chuck threads

preferably, of mild-steel. The tool is worked along the thread from start to finish and will push the chips in front of it.

Chips usually collect within the chuck when drilling or boring right through a piece of work, and to prevent this a piece of rag or cotton wool should be packed behind the work. Whenever a

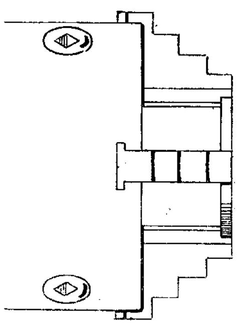


Fig. 2. Showing how chuck jaws may be strained

chuck is removed from the lathe, stand it with the backplate uppermost so that the chips tend to fall away from the threaded portion.

Until experience in handling chucks has been gained, it is a wise precaution to place a piece of wood on the lathe bed, so that should the chuck fall from the hand no damage will be done. When mounting a chuck, it should be rotated quickly on the final quarter of a turn in order to seat it firmly against the mandrel face.

Some workers experience difficulty in removing chucks, but if the usual practice is followed this is easily done; the back-gear wheels are put into mesh and a firm pull on the chuck key, inserted in one of its slots, should not fail to release a properly-fitted chuck. If no back gear is fitted, or the strength of its gear teeth is in doubt, a tapered piece of hard wood should be wedged between the mandrel cone pulley and the head-stock casting, but remember that the wedging force is borne by the mandrel and its bearings and so must not be excessive.

Wear will be prevented if the scroll of the self-centring chuck and the jaw screws of the four-jaw independent chuck are kept clean and well lubricated. Thin grease or solidified oil is better for this purpose than ordinary oil as it does not tend to be flung over surrounding objects, including the clothes, when the chuck revolves.

If a chuck is considerately used it will, if of reliable make, give good and long service, but many chucks are strained by applying excessive force to the chuck key, sometimes by means of a piece of tubing added to gain greater leverage. The cross-handle of a chuck key is purposely limited in length by the makers in an attempt to safeguard the chuck from brutal treatment. If the work slips in the chuck when moderately tightened, it is the manner of mounting that is at fault and not the chuck; a piece of hexagon material will not turn when gripped in a three-jaw chuck, nor will a round shaft fitted with a cross-pin.

Another way in which chucks are often strained is by gripping a piece of material in the extreme ends of the jaws, as depicted in Fig. 2, and then tightening with more than moderate pressure. This practice exerts a heavy and often destructive leverage on the slides in which the jaws work, with the result that in time the jaws are tipped outwards and have a bell-mouthed appearance.

Much time and effort is often wasted in changing the jaws of a four-jaw chuck from the inside- to the outside-holding position. Although this

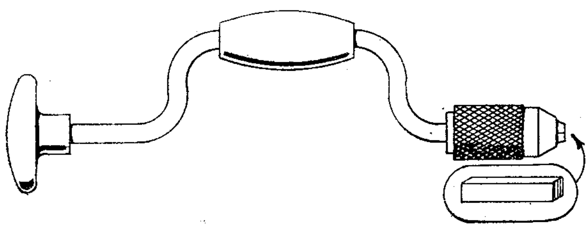


Fig. 3. Hand brace and square bit for operating the chuck jaws

is usually done with the chuck key provided, it is quicker and simpler to take a short length of square steel which fits the key slot and grip it in the brace, as represented in Fig. 3; this will enable the jaws to be removed and replaced quickly and with very little effort.

When changing the jaws of a three-jaw self-centring chuck from, say, inside- to outside-holding, one set of jaws is first removed and the second set is laid out in order according to the numbers 1, 2, 3, stamped on them.

The scroll is then turned with the key until

the start of the scroll thread is just short of the slot for No. 1 jaw. This jaw is then inserted and pushed well home, so that as the scroll is turned forwards the jaw is felt to travel inwards. Make sure that the end of the scroll thread has not reached No. 2 slot, then insert this jaw and turn the key forward for a short distance; finally engage No. 3 jaw in a similar manner. If any undue resistance to turning the key is felt while the jaws are being engaged, it probably means that the jaw in question is not properly home against the scroll; this is liable to happen in a new chuck where the jaws fit tightly, and can be overcome by lightly tapping the jaw inwards with a piece of wood or a small rawhide mallet until the key turns freely.

Lathe Centres

Two coned centres are usually supplied with the lathe; one of these is unhardened and is used in the lathe mandrel as it turns with the work and so is not subjected to wear.

The other, the hardened centre, is fitted to the tailstock barrel where it takes the end thrust as well as the rubbing contact of the rotating work. For this reason the back centre must always be kept well lubricated, and even then it may be found that soft metals such as brass tend to adhere to the tip of the centre and form a coating on it. When this happens, the adhering metal can usually be scraped off with a piece of unhardened steel so as not to damage the surface of the cone.

Should the end of the centre become scored, it will have to be reground before it is again fit for use. Centres are often maltreated when being removed, and this should be avoided at all costs. Where the centre fits into a hollow mandrel or tailstock it can be readily removed with the aid of a length of round rod, known as a bumper, inserted in the bore and used to strike a light blow on the base of the centre. On no account should centres be struck on the side with a hammer in an attempt to loosen them, nor should they be gripped with pliers.

Some centres are cross-drilled and can then be easily removed by giving them a partial turn with a short tommy bar; others are provided with spanner flats which in some cases fit no standard size of spanner. In the latter event, it is best to make a small spanner and keep it for this duty. The easiest way to do this, perhaps, is to take a piece of mild-steel, $\frac{3}{16}$ in. or $\frac{1}{4}$ in. thick, and

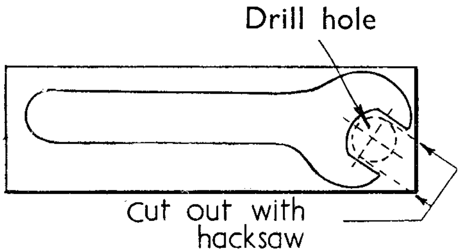


Fig. 4. Making a spanner

paint it with marking fluid. Clamp a spanner nearest to the correct size to the material by gripping both in the vice, and then mark-out the shape of the spanner head and its gaps with a scriber. Next, as shown in Fig. 4, mark-out the centre of the slot and follow this by drilling a hole equal in diameter to the measurement over the flats on the coned centre. Use a small hacksaw to cut out the gap rather undersize and file the jaws carefully to fit the lathe centre closely. Although it is advisable to case-harden the finished tool, a soft spanner, if carefully used, will withstand much use.

Utility Steam Engines

(*Continued from page* 55)

clearancing the mouth of the port, are best carried out by the use of a simple hand tool, which will be described later.

The drilling of the steam and exhaust ports has all the makings of a tricky business, but is facilitated by the use of a simple jig, as illustrated. It consists of a block of steel or other metal, machined on one face with a spigot to fit the recess in the cylinder-head, and cut at a angle of 30 deg. to this face on one side. The block is attached to the head by a bolt through the drain plug hole, and the assembly set up in a machine vice, on a tilting table, or clamped to the side of an angle-plate, at the appropriate angle to ensure that the holes are drilled at an angle of 60 deg. to the cylinder axis.

The exhaust valve outlet port may be tapped as shown, or the pipe may be attached by a circular or square flange, as there is plenty of room to fit four 8-B.A. screws in the top face of the head. Note that the passage must be drilled at an angle to avoid breaking into the valve seating, which would be fatal. But should mishaps of this nature occur—as they do occasionally in the best regulated workshops — it is possible to save the situation by opening out the valve bores and fitting inserted bronze seatings.

The steam admission-valve cover plate is also made in bronze, and the machining consists only of facing the joint surface, drilling the valve clearance pocket, and the entry hole at right-angles to it. After it has been fitted in place, the steam pipe, which is, of course, branched, and fed from a tee-piece at or near the centre, may be bent to shape, and brazed into the two cover plates at the ends.

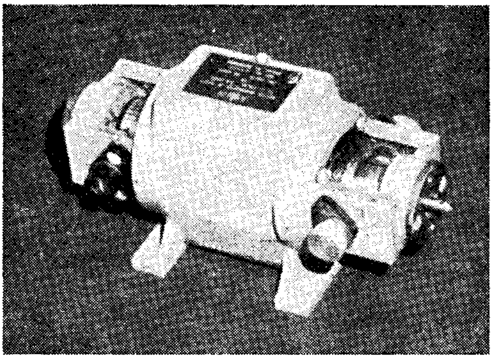
(*To be continued*)

A 500-Volt Insulation Tester

From Government Surplus

by Stuart H. Rutherford

A RECENT advertisement by Galpin's of Lewisham in THE MODEL ENGINEER, described some I.F.F. sets containing a motor generator with an output of 480 V. This figure, by reason of its proximity to the standard 500, suggested the use of the generator as the basis of an insulation tester.



The generator

On investigation, I found that these generators have a permanent field magnet, therefore being suitable for conversion to hand drive, so one of the sets was purchased.

The indicating meters used in insulation testers, are of the ratiometer type, having two windings, so arranged that the indication is determined by the ratio of the currents in the two coils, and is independent of the actual current values. For use as resistance meters, one coil is fed with current through a fixed resistance, while the other, fed from the same supply has connected in series with it, in addition to a limiting resistance, the resistance under test. An insulator is really a material of very high resistance, so its insulating qualities are measured by means of a high-reading resistance meter, which is what the present instrument constitutes.

Ratiometer instruments are used for a variety of purposes on aircraft. They are connected in a resistance bridge circuit, one arm of which is variable, and calibrated in the units they are measuring, current being supplied from the main battery. I obtained such a meter, calibrated as an air thermometer, from Aero Spares Ltd. of Church Street, Edgware Road.

It was now necessary to obtain gearing suitable for the hand drive of the generator, and after much searching, I found, at Emms of Coleherne Mews, Earls Court, some primary fibre gear wheels, complete on spindles with ball-bearings and a nut to secure a handle, and also some pinions suitable for mounting on the generator spindle, but no intermediate gears. Mr. Emms was, however, able to refer me to the Universal Ball Bearing Co. of Hammersmith Grove, to whom he had supplied some, and from them I obtained one, complete with ball-bearings. A gearbox was made up from 16-gauge sheet obtained from the I.F.F. chassis. It consists of two pieces, flanged up so that one fits inside the other. The flanges are bolted together at the sides of the secondary gears and at the top of the box, and the whole is held to the generator by two screws fitted into existing holes in the bearing.

Careful measurements of the gears were made to determine the distances between the centres of the spindles. Discs of steel about $\frac{3}{8}$ in. thick were then turned up 0.0005 in. smaller than the outside diameters of the ball-bearings, and drilled about $\frac{1}{4}$ in. at the centre. Another disc was also turned up with a diameter equal to the distance between the centres of the shafts minus half the sum of the diameters of the first two discs. The positions of the centres of the shafts were then set out on the front of the box by rule and scriber, and $\frac{3}{16}$ in. diameter holes drilled at these points. The discs corresponding to the ball-bearings were fixed to these holes with 2-B.A. bolts, one being located as accurately as possible from the setting-out lines, and its bolt tightened securely. The third disc was now held between the first two and used as a gauge to locate the second at the correct distance from the first, the bolt of the second being then tightened securely. At this stage, the box was mounted on the lathe faceplate, one of the discs centred to run truly, and the box firmly clamped. The centred disc was then removed and a hole bored in the box to a size that the disc would just enter without shake. This made the hole a tight fit on its ball-bearing. The hole at the back of the box was bored at the same setting through the front one, thus ensuring concentricity. The process was repeated for the other bearings. A hole was drilled in the backplate to clear the generator pinion.

The generator pinion was reamed out in the lathe to fit its shaft. A hole was drilled through its boss and the shaft, and a pin pushed through and riveted up both ends.

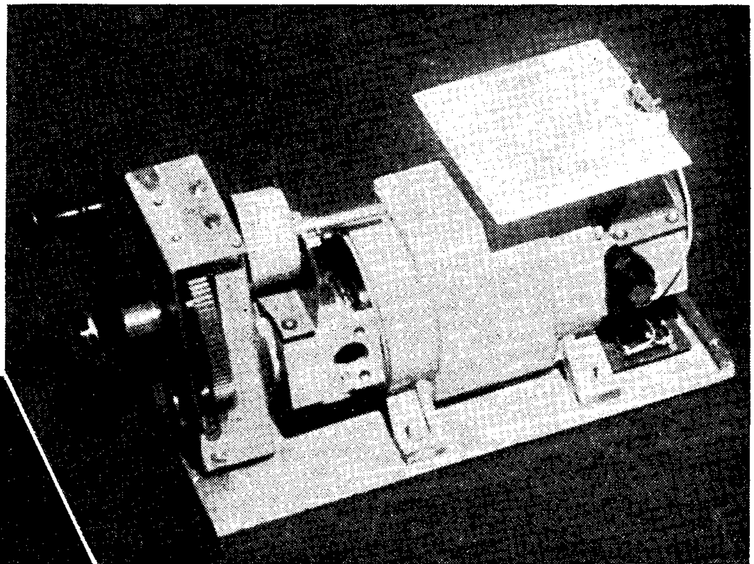
Holes were drilled in the plates of the gearbox close to the bearings to take large headed self-tapping screws, the heads of which prevented the bearings sliding out of their housings. A little shellac applied to the threads prevents the screws working loose.

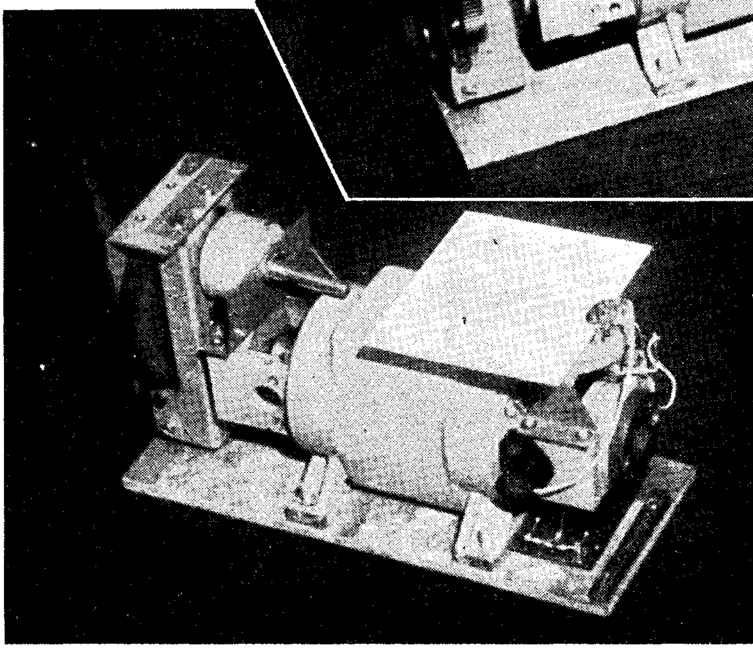
A handle that had previously operated a car window was found in the scrap box and drilled out to fit the primary shaft. A substantial pin was already fitted through the shaft, and a slot

was filed across the back of the handle to fit over this. The handle is held in position by the nut supplied with the spindle.

The meter movement was now removed from its case and attached to the generator above the high tension commutator by means of two Z-shaped brackets secured to the brush housing by means of screws inserted into tapped holes already existing.

The common connection to the coils is taken out through the hairspring at the front of the instrument, and the others through thin ligaments at the back. The hairspring is provided on aircraft instruments to pull the pointer to the low end of the scale when the meter is not energised. On commercial insulation testers, there is usually no hairspring, another ligament serving as the common connection. These ligaments are very light, about 0.0005 in. thick and 0.01 in. wide, and exert a much smaller restraint on the coil than a hairspring. I decided to replace the hairspring with a ligament, though this wasn't strictly necessary. Handling these ligaments is a bit tricky when you are not used to it, the procedure being to hold them in a pair of tweezers and watch progress with a watchmaker's eyeglass. A length of suitable foil strip was first cut off with a razor blade, and then bent into a curve by laying it on a flat surface and stroking very gently with a knife-blade. It was then offered up to one of its anchorages with the tweezers, the anchorage having previously been tinned with resin cored solder, leaving a little resin on the tinning. Then a very small iron, heated just sufficiently to melt solder and no more, was applied to the anchorage near to the ligament. When the solder melted, the iron was quickly removed, because, if the solder is allowed to get too hot, it dissolves the end right off the ligament! When one end was fixed, the process was repeated with the other one.

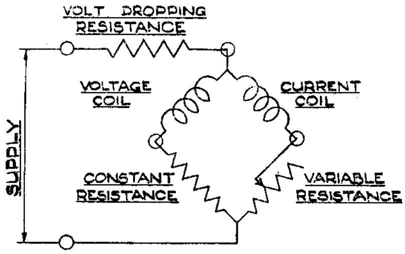




Two views of the assembled instrument

The gap in the magnet for the coil was now cleared of small metal particles which had collected there, by wiping with a small piece of self-sticking adhesive tape, held in a pair of non-magnetic tweezers. The coil has to swing absolutely freely.

A large rectangular dial was made from a piece of thin sheet steel. The positions of the fixing holes and the recess to clear the pointer were set out from the old dial, and the size made such that it would go comfortably into the proposed wooden case, while allowing about 90 deg. of



Circuit of ratiometer as used in aircraft

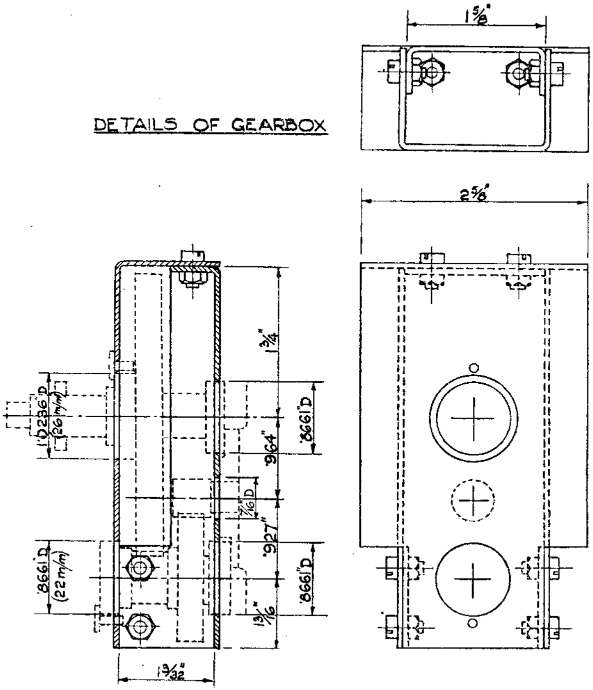
pointer movement. It was enamelled white with cellulose enamel, and when dry was made slightly matt with very fine glass-paper used wet. I managed to obtain a piece of aluminium pointer tube. This is very light and thin walled. The original pointer was removed from the four-armed aluminium "spider" attached to the coil assembly, and the new pointer pushed on to the arm of the "spider," using a spot of shellac varnish to secure it. The free end of the pointer was flattened to form a knife edge to facilitate reading.

After fitting the new pointer, the assembly was re-balanced with weights fitted to two arms of the "spider," consisting of pieces of copper wire wound into a tight spiral that will just slip over the arm, and stuck in position with shellac varnish. This was dried off with a warm soldering iron. The weights were adjusted along their arms until the pointer was not perceptibly moved by tilting the instrument.

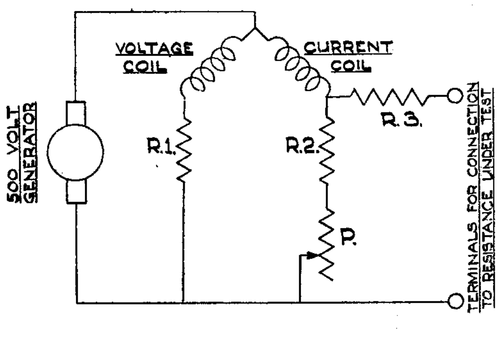
Suitable values for the various resistors were ascertained by trial and error until an open calibration, with the 2 megohm mark near the centre, was obtained. An accumulation of old carbon resistors was drawn upon for the initial experiments. When values had been decided, new resistors of the cracked carbon high stability type were purchased.

Referring to the wiring diagram, the resistor $R1$ is in series with one coil of the meter The resistor $R2$, of about the same value, is in series with the other coil, and a wire-wound potentiometer P of 20,000 ohms used as a rheostat to make final adjustments. It was necessary to see that the generator was connected the right way round, the common connection of the coils in my meter goes to negative. With the terminals on open circuit, the rheostat P was adjusted until, when the generator was turned, the pointer took up a position at the left-hand end of the scale looking from the coil, this being the position at which infinite resistance or perfect insulation is indicated. The value of resistor $R3$, is such that when the generator is turned

DETAILS OF GEARBOX



with the terminals short circuited, the pointer moves to the right-hand end of the scale, corresponding to zero resistance. In order to obtain the necessary accuracy I used two resistors, one of high resistance and the other of low resistance as a trimmer.



Circuit of insulation tester

Calibrating

The infinity and zero calibrations were marked on the dial with a sharp, soft pencil, and calibration of a number of other points determined by connecting resistors, whose actual resistance had been ascertained with a borrowed Megger, across the terminals and turning the generator. The remainder of the scale was filled in by interpolation, and when complete, the dial was "engraved" with Indian ink.

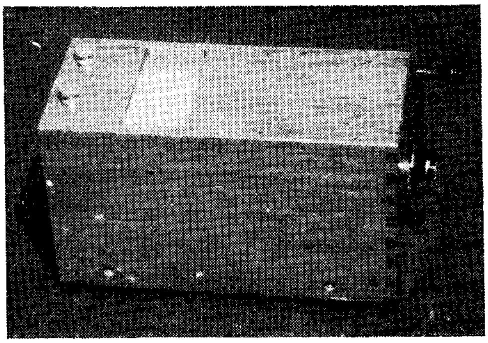
The resistors are secured to a small piece of Tufnol sheet mounted under the high-tension

brush housing, and the potentiometer on a bracket attached to the top of the low-tension brush housing. The low-tension brushes were removed to eliminate friction.

I acquired a cedar wood box from Galpin's which, when cut in half and suitably reconstructed, furnished a fairly presentable case. A window was cut in the top over the dial, and a piece of thin Perspex fitted, and a hole was cut in the end to accommodate the handle spindle.

The generator was attached to the bottom of the case by four screws.

In conclusion, the instrument has proved very satisfactory, and anyone who likes to go to the trouble of making one will find his labours well rewarded.



The finished article

PRACTICAL LETTERS

An Appreciation, and a Criticism

DEAR SIR,—Please allow me to thank B.C.J. for his delightful article on "Why Not a Steam Engine?" in the November 10th issue.

In the articles on "Steam Cylinder Passages," Mr. K. N. Harris condemns a certain popular design of small-scale locomotive cylinder on the grounds that its passages are inadequate and each contain two sharp right-angle bends. He then proceeds to describe a rather difficult method of building-up a cylinder which really does possess passages with two sharp-cornered right-angled bends. With regard to the cross-sectional area of the passages, surely the piston speed determines the passage-to-bore area ratio, and, as the maximum piston speed of a small-scale locomotive is but a fraction of that obtaining in a full-size engine, it would appear to be perfectly logical and correct to reduce the cross-sectional area well below scale size, and thus minimise the clearance volume.

It is no use Mr. Harris telling the model engineering world that small locomotives, whose steam-passages are smaller than the ports, are hopelessly inefficient—so many builders have proved otherwise. I agree that his cylinder design would give a large power output at high r.p.m. with a late cut-off. I am, however, quite certain that the steam consumption would be greatly in excess of that of cylinders with large ports and bores, and moderate passage area.

I have noticed that certain full-size locomotives, which have abnormally large passages, for instance, the Bulleid Pacifics, are extremely powerful, but are worked at fairly late cut-off, and their coal consumption is heavy, in spite of their very free exhaust. I have a great admiration for a lot of Mr. Bulleid's work, but cannot help thinking that the large passages on his engines account for that heavy consumption. Opinion of others would be very interesting on this point.

I cannot agree with the statement that the passages of a small steam cylinder should be as large as, if not larger than, the ports. The latter, in small steam locomotives, are usually made as large as the steam chest will permit—far larger than are necessary to pass the required amount of steam—in order to overcome the defects of a valve-gear, i.e. the slow opening and closing of the ports.

Yours faithfully,

Aldbourne, Wilts. J. KNIGHTBRIDGE.

Model Car Articles Wanted

DEAR SIR,—The fact that model car racing is degenerating to the extent that the time is approaching when it simply means that the "models" are the best that money can buy, is fast becoming apparent.

May I suggest that to counteract this, more articles on this subject, including constructional ones, and news of model car events should again appear in THE MODEL ENGINEER, thus bringing the movement to the notice of the whole of the model engineering fraternity.

There seems a tendency at present to develop the separate interests into watertight compartments, and other news of general interest does not appear. I am aware that this subject is covered in *The Model Car News*, but some should also appear in THE MODEL ENGINEER if new recruits of the right type are to be found.

It is quite possible that the future development, or even the very existence of the model car movement, depends on the attitude taken by THE MODEL ENGINEER in the very near future.

Yours faithfully,

Nuneaton. A. E. HASWELL.

Amusing Registration Numbers

DEAR SIR,—When cars were first registered, a friend of mine was Lord Lieutenant of Dorsetshire. This county was allotted the letters B.F. My friend explained to the authorities that he thought it unfair that he should be expected to label himself B.F. 1. The authorities were sympathetic and the letters for the County were changed!

Yours faithfully,

Knebworth. CECIL E. BANBURY, Major.

An Unconventional Centre Engine

DEAR SIR,—I was very interested in Mr. Denty's letter re Mr. Charles Heal's centre engine that drove his magnificent set of gallopers. I know of a similar set that was once owned by the late Mr. Jacob Studt Snr., and finished up in the ownership of Mr. L. Way of Cardiff. The centre engine on this machine was called "The Maid of Cefn Ydfa." It had a dummy funnel with a huge brass collar and the organ model was placed beside the firebox. This machine was built by Walkers of Worcester about 1906, and has since been broken up. The massive organ used to adorn the front of the late President Kemp's Bioscope Show. I trust that these few notes will be of interest to all.

Yours faithfully,

Cardiff. WILLIAM STAFFORD.

Joseph Bramah

DEAR SIR,—The article by Mr. W. J. Hughes (THE MODEL ENGINEER, dated November 24th, 1949) on Joseph Bramah gave some most interesting details concerning a famous engineer, of whom far too little is generally known nowadays. I, too, was most fortunate in being present at the celebrations on the bi-centenary of Bramah's birth. I was a member of a team of stewards provided by Barnsley Mining and Technical College, which contributed in no small measure to the success and smooth running of the celebrations.

For some time I travelled to and from Barnsley daily, passing the Tollgate Hotel on the journey. On many occasions, I noticed the showman's road locomotive, mentioned by Mr. Hughes, standing in the grounds of that hotel. I soon decided that I must investigate, and, if possible, examine this locomotive; but, most unfortunately, pressure of business prevented my carrying out this good intention. I am sorry to learn that such a thing will not now be possible; and I look forward, as I believe a great number of your readers will, to a descriptive article on the subject by Mr. Hughes.

Yours faithfully,

Wakefield. DONATI O. WHITEHEAD.

Making Name-plates

DEAR SIR,—Mr. W. J. Hughes's article under the above title made very interesting reading, but there are one or two statements in it which may be misleading.

It is *not* necessary to draw the name-plate in reverse, as the blockmakers themselves can effect this reversal simply by laying the film negative the other way down on the second glass-plate during their process. This is an important point, because many people find it difficult enough to draw accurate lettering the right way round, let alone "back-to-front"!

When blocks are to be made in this way they should be ordered "In reverse, left to right." When sunk letters on a flat background are required, order the block, "In reverse, black to white," and in this case it will be necessary to indicate the border of the plate or "black surface by pencilling the required profile outside the black letters which otherwise would be surrounded by an expanse of white on the original.

The minimum charge of 13s. 7d. for a line block of not more than 14 sq. in. includes mounting the metal on a wooden base, by the way. The metal can be supplied unmounted, of course, but in the case of a small number of blocks, it is doubtful whether this would enable any reduction in price to be made.

Yours faithfully,

Dartford. G. M. J. CHESMORE.

International Racing

DEAR SIR,—I enjoyed reading Mr. Stone's reply to my letter criticising his article, "The Swiss International Regatta." Had his contribution been written in a similar tone it would not have aroused any comment.

I cannot agree with Mr. Stone that the engine is less than 90 per cent. of the boat. My own engine took four years to construct and develop and during that time considerably less than six months were spent on hulls, etc. Another advantage in favour of the commercial engine is that there is one "unknown" less to worry about. I could have bought an engine and taken the easy way out. The two-point suspension was introduced to make power boating easier. Now I read in M. Suzor's description of the French regatta that the two-foot bridle should be increased to one of four feet, admittedly to make it easier still.

A further step would be the importation of a completed commercial boat. The M.P.B.A. had the foresight to create a separate class for commercial engines, and any international regatta should have similar classes. The model car authorities did not take this step, with the result that Mr. Buck, among others, has to compete with the Dooling car, complete with a Dooling engine which at present holds the British 10 c.c. car record. Mr. Buck is to be congratulated in the way he keeps on their tails with his home-constructed car and engine. The chances of the home constructor ever equalling the commercial engine are very slender. Apart from the comparatively crude equipment, with which he is usually compelled to work on account of expense, the time factor plays a big part. The commercial producer can do as much development work in a week as the average amateur does in a year.

In a recent edition of a contemporary journal there is a paragraph stating that model car racing in America is dead, having had a life of about ten years. They blame the high speeds now being obtained, which is a direct result of commercialisation. Model car racing appears to have declined somewhat in this country, and we do not want the same thing to happen to power boating.

If Mr. Stone has never designed and constructed a small i.c. engine, he has no idea of the difficulties overcome by the home constructors. It is, in my opinion, by far the most difficult branch of model engineering.

Yours faithfully,

Runcorn. R. E. MITCHELL.